THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST.

---

**Economic Paper No. 11.**

---

# THE MINING INDUSTRY

IN

## NORTH CAROLINA DURING 1905

BY

JOSEPH HYDE PRATT, PH.D.

RALEIGH
E. M. UZZELL & CO., STATE PRINTERS AND BINDERS
1907

THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST.

---

**Economic Paper No. 11.**

# THE MINING INDUSTRY

IN

## NORTH CAROLINA DURING 1905

BY

JOSEPH HYDE PRATT, PH.D.

RALEIGH
E. M. UZZELL & CO., STATE PRINTERS AND BINDERS
1907

## GEOLOGICAL BOARD.

GOVERNOR R. B. GLENN, *ex officio Chairman*.....Raleigh.
HENRY E. FRIES.....Winston-Salem.
FRANK R. HEWITT.....Asheville.
HUGH MACRAE.....Wilmington.
FRANK WOOD.....Edenton.

JOSEPH HYDE PRATT, State Geologist.....Chapel Hill.

# LETTER OF TRANSMITTAL.

CHAPEL HILL, N. C., December 1, 1906.

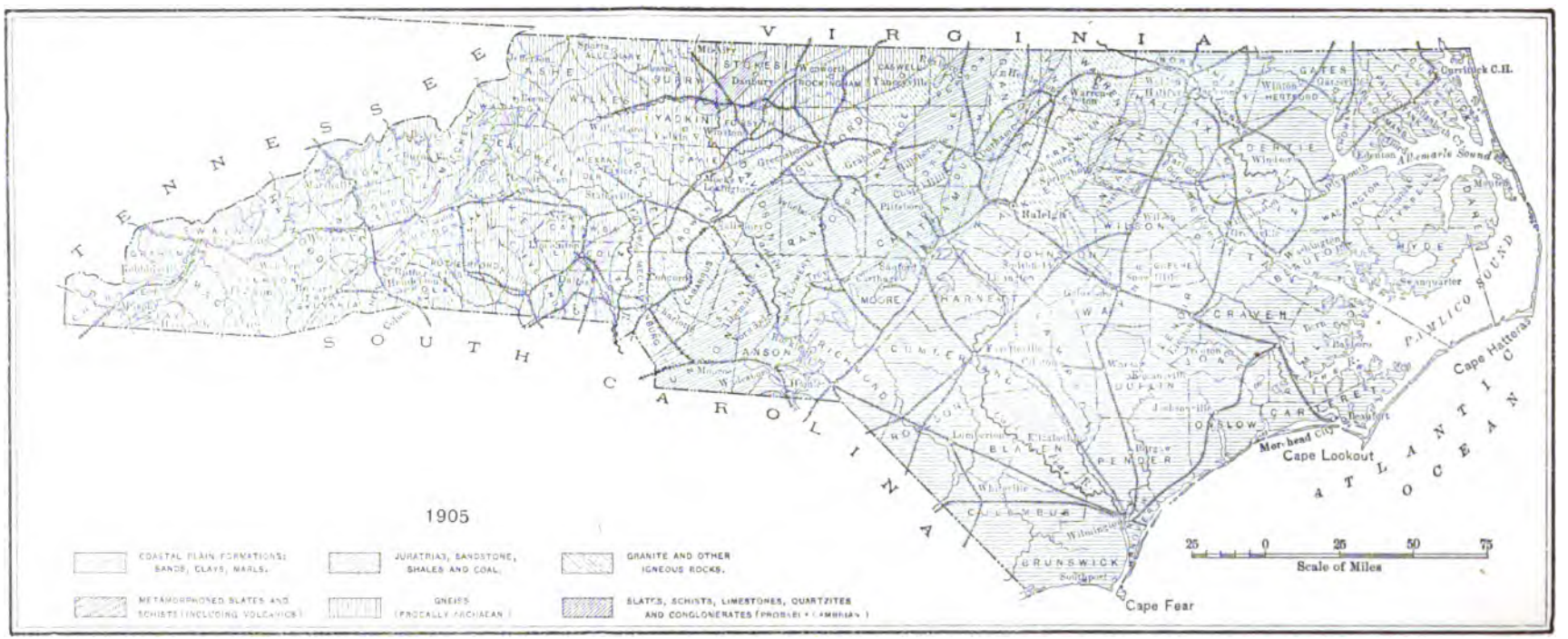
*To His Excellency,* HON. ROBERT B. GLENN,
*Governor of North Carolina.*

SIR:—I herewith have the honor to submit for publication Economic Paper No. 11, a Report on the Mining Industry in North Carolina for the Year 1905. In order to satisfy certain inquiries that are being received regarding the mining laws of North Carolina, there is given at the end of this report a list of the mining laws as given in the Revisal of The Code for 1905.

Yours obediently,

JOSEPH HYDE PRATT,
*State Geologist.*

# CONTENTS.


V I R G I N I A
T E N N E S S E E
S O U T H C A R O L I N A
A T L A N T I C O C E A N
Currituck C.H.
Albemarle Sound
Pamlico Sound
Cape Hatteras
Cape Lookout
Cape Fear
Morehead City
Raleigh
Scale of Miles
25 0 25 50 75
1905
COASTAL PLAIN FORMATIONS: SANDS, CLAYS, MARLS.
JURATRIAS, SANDSTONE, SHALES AND COAL.
GRANITE AND OTHER IGNEOUS ROCKS.
METAMORPHOSED SLATES AND SCHISTS (INCLUDING VOLCANICS)
GNEISS (PROBABLY ARCHAEAN)
SLATES, SCHISTS, LIMESTONES, QUARTZITES AND CONGLOMERATES (PROBABLY CAMBRIAN)

# MINING INDUSTRY IN NORTH CAROLINA DURING 1905.

By JOSEPH HYDE PRATT.

## INTRODUCTION.

It is gratifying to note that during the year 1905 there was a decided increase in the production of those minerals which constitute North Carolina's chief mineral resources. Thus the productions of talc and soapstone, monazite, mica, building stones and clay products showed a very marked increase over the productions of 1904. In regard to building stones, the 1905 production was nearly twice that of the previous year and shows the remarkable growth of the building-stone industry in the State, due to systematic advertising and increased efficiency of quarrying methods. The Survey has coöperated with the producers of building stones and done all in its power to advance this industry in the State.

The production of clay products, which has constantly increased in value during the past five years, showed a decided gain in 1905, especially in value. Notwithstanding the large demand for brick and other clay products in the State and the increase in the value of these products, there is still a lack of enterprise on the part of most of the manufacturers of these in adopting new and up-to-date methods for working these clays. Thus they are only able to make the lowest grade of clay products, which are not able to command the high prices that are paid for a better quality of goods, the greater portion of which is now imported into North Carolina.

Of the two minerals, monazite and mica, North Carolina produces the greatest amounts of any State in the Union, and during 1905 it very largely increased its production of monazite as compared with that of 1904. The production of mica was only slightly increased over that of the previous year.

Of the heavy metals, such as gold, silver, and copper, North Carolina's production does not play a very important part at the present time in the total production of these mines in this country. Although

the increase in the value of the production of these metals in 1905 as compared with 1904 was not large, yet there has continued to be a large amount of systematic development work carried on which has resulted in the opening of ore bodies of economic importance which will undoubtedly be mined and their metal contents placed on the market in the near future. A systematic investigation has been made during the past summer of the gold and copper mines of the State, and a preliminary report of the results of these investigations will be published shortly as an Economic Paper of the Survey publications.

Another mineral product that has caused considerable interest to center in North Carolina is tin, which has been mined in Gaston and Lincoln counties. Although the actual value of these tin deposits is still problematic and their success dependent largely on efficient management, yet the scarcity of this metal makes the North Carolina deposits of extreme interest, and a number of them are worthy of development, as they do offer possible chances of profitable investment if properly and economically managed.

The mining and quarrying industries of the State, as a whole, are perhaps in the most prosperous and flourishing condition ever known in the history of the State, and this cannot help but mean still greater activity in mining and a larger investment in the mineral resources of the State.

During 1905 the total value of the mineral production of North Carolina* was $2,439,381 as compared with $1,946,273 in 1904, an increase of $493,108. This increase is 25 per cent of the total production of 1904. The minerals and ores that have been mined in North Carolina during 1905 are given below in the order in which they are discussed in this report: Gold and Silver; Copper; Iron; Tin; Abrasive Materials (Corundum, Garnet, Millstones); Mica; Quartz (Flint); Barytes, Monazite and Zircon; Talc and Soapstone; Precious Stones; Mineral Waters; Graphite; Coal; Peat; Stone (Granite, Sandstone, Marble, and Limestone); Sand and Gravel; Sand-lime Brick; Kaolin and Clay Products; and Heavy Black Sands.

* In the collection of the statistics of the production of the various minerals the State Survey has had the co-operation of the Department of Mineral Resources of the U. S. Geological Survey.

## GOLD AND SILVER.

### PRODUCTION.

The deposits of gold and silver have been described in detail in previous reports;* and still another report is now being prepared which will supplement the previous publications on these subjects. For this reason no attempt is made in the present report to give any description of the new work that has been done in the mining of these metals.

There was a small increase reported in the production of gold and silver in 1905 as compared with that of 1904. The total coining value of this production in 1905 was $149,369, which is an increase of $6,312 as compared with $143,057, the value of the production of 1904. Of the 1905 production $129,153 was due to the value of the gold produced, an increase of $5,229 as compared with $123,924, the value of the 1904 production. The value of the silver production was $20,216 as compared with $19,133 in 1904, an increase of $1,083. This production of 1905 consisted of 6,273 fine ounces of gold and 20,364 fine ounces of silver. The largest production of gold was from Montgomery County, with a production of gold valued at $61,000 and of silver at $1,600. Cabarrus County was second with a production of gold valued at $22,836, and of silver at $53.

On account of the death of Prof. George B. Hanna, Director of the United States Government Assay Office at Charlotte, N. C., in the spring of 1906, who had charge of the collecting and tabulating of the gold and silver statistics for North Carolina, it has been impossible this year to give these statistics in as much detail as in former years. Usually, it has been possible to give a list of all the counties producing gold, with the value of the production of each, and also to give a list of the principal producing mines. This year, however, it will simply be possible to give an approximate statement regarding the production of the principal producing counties, which is given in the following table.

* Bulletins 3 and 10, Economic Papers 6, 8 and 9, N. C. Geological Survey.

PRODUCTION OF GOLD AND SILVER IN 1905 BY COUNTIES.*

| County. | 1905. | | |
|---|---|---|---|
| | GOLD.† | SILVER.† | TOTAL.† |
| Burke | $ 1,000 | $ 15 | $ 1,015 |
| Cabarrus | 22,836 | 53 | 22,889 |
| Catawba | 3,500 | 81 | 3,581 |
| Davidson | 1,000 | 420 | 1,420 |
| Guilford | 9,000 | 30 | 9,030 |
| McDowell | 500 | 10 | 510 |
| Mecklenburg | 4,200 | 12 | 4,212 |
| Montgomery | 61,000 | 1,600 | 62,600 |
| Nash | 2,000 | 6 | 2,006 |
| Rowan | 7,200 | 17,600 | 24,800 |
| Stanly | 10,000 | 140 | 10,140 |
| Union | 4,948 | 29 | 4,977 |
| Unknown | 1,969 | 220 | 2,189 |
| Total | $129,153 | $20,216 | $149,369 |

As is seen from the above, the production of silver is obtained chiefly from Rowan County, which was the only county producing copper during 1905.

* The gold and silver statistics have been obtained through the courtesy of Mr. George C. Roberts, Director of the Mint, Washington, D. C. The counties given in this table do not represent all the producing counties, but the production has been given as far as possible to the principal producing counties and the balance is given as "Unknown." This latter undoubtedly includes a dozen or more counties.

† Coining value.

In the following table there is given the production of gold and silver in 1903 and 1904 by counties:

PRODUCTION OF GOLD AND SILVER IN 1903 AND 1904 BY COUNTIES.*

| County. | 1903 | | | 1904 | | |
|---|---|---|---|---|---|---|
| | Gold.† | Silver.† | Total.† | Gold.† | Silver.† | Total.† |
| Alamance | $ | $ | $ | $ 23.26 | $ .27 | $ 23.53 |
| Anson | | | | 52.56 | 1.32 | 53.88 |
| Burke | 1,606.44 | 17.09 | 1,623.53 | 1,507.03 | 23.03 | 1,530.06 |
| Cabarrus | 3,237.23 | 85.93 | 3,323.16 | 14,889.80 | 193.08 | 15,082.88 |
| Caldwell | 41.10 | .87 | 41.97 | 46.52 | .41 | 46.93 |
| Catawba | 1,181.07 | 19.09 | 1,200.16 | 5,438.29 | 105.75 | 5,544.04 |
| Chatham | | | | 96.74 | 1.60 | 98.34 |
| Cherokee | 1,144.52 | 5.91 | 1,150.43 | 123.76 | .74 | 124.50 |
| Clay | 46.51 | .29 | 46.80 | 57.90 | .36 | 58.26 |
| Cleveland | 5,269.40 | 1.16 | 5,270.56 | 180.47 | 4.46 | 184.93 |
| Davidson | 230.12 | 161.52 | 391.64 | 1,102.77 | 590.91 | 1,693.68 |
| Franklin | 162.79 | 2.48 | 165.27 | 88.37 | 1.86 | 90.23 |
| Gaston | 196.84 | 2.85 | 199.69 | 217.88 | 4.71 | 222.59 |
| Granville | 562.68 | 2,258.97 | 2,821.65 | 610.07 | 1,189.05 | 1,799.12 |
| Guilford | 3,806.62 | 159.16 | 3,965.78 | 12,853.11 | 46.16 | 12,899.27 |
| Halifax | 423.81 | 2.63 | 426.44 | 178.54 | 1.45 | 179.99 |
| Henderson | 186.05 | 2.33 | 188.38 | 32.31 | .37 | 32.68 |
| Iredell | 133.84 | 1.60 | 135.44 | 162.20 | 2.51 | 164.71 |
| Lincoln | 522.42 | 9.90 | 532.32 | 35.03 | .84 | 35.87 |
| Macon | 93.02 | .58 | 93.60 | 46.52 | .30 | 46.82 |
| McDowell | 2,260.15 | 30.60 | 2,290.75 | 602.78 | 14.10 | 616.88 |
| Mecklenburg | 8,578.72 | 102.89 | 8,681.61 | 1,157.99 | 25.04 | 1,183.03 |
| Montgomery | 48,634.83 | 878.27 | 49,513.10 | 50,460.88 | 901.46 | 51,362.34 |
| Moore | 388.87 | 8.04 | 396.91 | 310.46 | 7.04 | 317.50 |
| Nash | 139.54 | 2.15 | 141.69 | 44.18 | .95 | 45.13 |
| Orange | 351.46 | 5.11 | 356.57 | 23.26 | .15 | 23.41 |
| Person | 1,096.15 | 8,632.24 | 9,728.39 | 171.50 | 2,734.51 | 2,906.01 |
| Polk | 602.21 | 4.22 | 606.43 | 192.78 | 1.86 | 194.64 |
| Randolph | 396.30 | 6.96 | 403.26 | 397.62 | 12.99 | 410.61 |
| Rowan | 1,852.39 | 4,119.21 | 5,971.60 | 4,163.72 | 12,852.09 | 17,015.81 |
| Rutherford | 1,322.20 | 16.91 | 1,339.01 | 484.95 | 3.24 | 488.19 |
| Stanly | 24,524.30 | 116.05 | 24,640.35 | 17,113.65 | 157.32 | 17,270.97 |
| Union | 3,101.84 | 95.68 | 3,197.52 | 9,677.08 | 224.56 | 9,901.64 |
| Warren | 139.54 | 1.75 | 141.29 | 359.07 | 2.36 | 361.43 |
| Unknown | 1,370.59 | 154.22 | 1,524.81 | 1,020.95 | 25.73 | 1,046.68 |
| Total | 113,603.55 | 16,906.66 | 130,510.11 | 123,924.00 | 19,132.58 | 143,056.58 |

* The gold and silver statistics have been obtained through the courtesy of Mr. Geo. B. Hanna, of the United States Government Assay Office, Charlotte, N. C.

† Coining value.

In the next table there is given the value of the gold and silver productions in North Carolina for the years 1882 to 1905, inclusive:

GOLD AND SILVER PRODUCTION IN NORTH CAROLINA FROM 1882 TO 1905.*

| YEAR. | GOLD. | SILVER. | TOTAL. |
|---|---|---|---|
| 1882 | $190,000 | $25,000 | $215,000 |
| 1883 | 167,000 | 3,000 | 170,000 |
| 1884 | 157,000 | 3,500 | 160,500 |
| 1885 | 152,000 | 3,000 | 155,000 |
| 1886 | 175,000 | 3,000 | 178,000 |
| 1887 | 225,000 | 5,000 | 230,000 |
| 1888 | 136,000 | 3,500 | 139,500 |
| 1889 | 145,000 | 3,878 | 148,878 |
| 1890 | 118,500 | 7,757 | 126,257 |
| 1891 | 95,000 | 6,465 | 101,465 |
| 1892 | 78,560 | 12,671 | 91,231 |
| 1893 | 53,600 | 17,325 | 70,925 |
| 1894 | 46,594 | 455 | 47,049 |
| 1895 | 54,200 | 520 | 54,720 |
| 1896 | 44,300 | 646 | 44,946 |
| 1897 | 34,600 | 388 | 34,988 |
| 1898 | 84,000 | 905 | 84,905 |
| 1899 | 34,500 | 388 | 34,888 |
| 1900 | 44,653 | 15,986 | 60,639 |
| 1901 | 60,410 | 34,023 | 94,433 |
| 1902 | 93,650 | 30,212 | 123,862 |
| 1903 | 113,604 | 16,907 | 130,511 |
| 1904 | 123,924 | 19,133 | 143,057 |
| 1905 | 129,153 | 20,216 | 149,369 |

*Coining value.

## COPPER.

### PRODUCTION.

The production of copper in 1905 was all from Rowan County and amounted to 10,000 tons of ore, of which the value of the copper contents was $88,000. Reckoning the copper at 18 cents per pound, this makes the total copper production equal to 488,888 pounds. As compared with the production of 305,000 pounds, valued at $36,600, in 1904, this is an increase of 183,888 pounds in quantity and of $51,400 in value. All this ore was shipped to the smelters at Ducktown, Tennessee. In the following table there is given the production of copper in North Carolina from 1900 to 1905:

PRODUCTION OF COPPER FROM 1900 TO 1905.

| YEAR. | CRUDE ORE MINED. | COPPER PRODUCED. | VALUE. |
|---|---|---|---|
| | *Tons.* | *Pounds.* | |
| 1900 | 6,948 | ..... | $ 41,600 |
| 1901 | 10,398 | 512,666 | 76,900 |
| 1902 | 16,741 | 1,417,020 | 212,553 |
| 1903 | 4,106 | 458,133 | 67,037 |
| 1904 | 4,250 | 305,000 | 36,600 |
| 1905 | 10,000 | 488,888 | 88,000 |

## COBALT.

During the past 18 months there has been considerable interest aroused in North Carolina regarding the location of deposits of minerals containing the metal, cobalt, due to the fact that Mr. Thomas Edison made a personal trip through the State apparently with the object in view of locating commercial sources of supply of this metal.

Cobalt is a metal that is very similar in its properties to nickel, and, with few exceptions, all minerals in nature that contain one of these metals contain also a small percentage of the other. In the reduction of the ores containing nickel and cobalt, they both go into the matte, which is afterwards refined and the two metals separated from each other. The demand for cobalt is not large and there is usually an overproduction of this metal, which is obtained as a by-product from nickel ores. For this reason there has been but little direct prospecting for new sources of supply of cobalt. The demand for nickel, however, has constantly increased, so that prospecting has been carried on in many sections of the country for deposits of this metal. Up to the past two years all the cobalt produced in the United States and Canada was as a by-product either in nickel or lead mining and smelting, and there had been no direct mining for cobalt ores. Recently, however, new sources of supply of cobalt, containing but little nickel, have been found in Canada, which have resulted in the production of cobalt in some quantity, and this could be very largely increased if a sufficient demand should be created for this metal. These deposits are in Canada, on the line of Temiscuming and North Ontario Railroad, 90 miles northeast of Sudbury. These ores carry a considerable percentage of cobalt and are rich in silver, thus making the ore very profitable mining.

In the United States there has been no direct mining for ores of cobalt, and that which has been produced has been associated with the lead ores mined at Mine La Motte, Mo., which contained a considerable percentage of cobalt and a very small quantity of nickel. A matte is obtained which contains nickel, cobalt, and copper, and a small quantity of lead. This is afterwards refined and the nickel and cobalt separated out. The cobalt is put on the market in the form of cobalt oxide, which is worth approximately $1 per pound.

The principal use of cobalt is in the manufacture of pigments, the principal one being known as cobalt blue. Some experiments have been made with cobalt for use in the manufacture of a specially hardened steel, which is the principal use of nickel. There is not, however, distinct enough difference in the properties imparted to steel by these two metals to warrant the use of cobalt as a steel or iron hardening metal so long as its cost is so much higher than nickel. If, however, a special use can be devised for it in the manufacture of storage batteries, as has been reported to be advocated by Mr. Thomas Edison, there should be a considerable increase in the demand for the metal, which would warrant more prospecting for sources of supply, although the present known supplies of this metal can satisfy a very large increase in the demand.

There are a number of minerals, principally sulphides, arsenides, and oxides, that contain a considerable percentage of cobalt, the principal ones being as follows:

*Linnæite.*—This mineral, known also as cobalt pyrites, is a pale steel-gray brittle mineral, which tarnishes quite readily to a copper-red color. It is as hard as steel and has a specific gravity of about 5. It is a copper sulphide ($Co_3S_4$) and is quite commonly found in octahedral crystals, but also occurs massive.

*Cobaltite.*—This mineral, also known as tin-white cobalt and gray cobalt, is a cobalt arsenic sulphide (CoAsS) of a silver-gray to steel-gray color, sometimes having a tinge of red or violet. It is quite commonly found in pyritohedral crystals of silver-white color, and also occurs massive, when the color is apt to change to a steel-gray or a grayish color. It is as hard as steel and about 6.5 in specific gravity.

*Smaltite.*—This mineral has a tin-white to steel-gray color and is 5.5 to 6 in hardness, its specific gravity being about 6.5. It is brittle

and commonly occurs massive. In composition it is essentially a cobalt di-arsenide ($CoAs_2$).

These minerals have not been found in any large masses, but are usually found more or less sparingly disseminated through rocks and associated in veins with other minerals. In decomposing or altering these would form carbonates, sulphates and oxides, which would be entirely different in appearance from the minerals from which they have been derived. The more common alteration product would be the oxide which is apt to be found largely mixed with other oxides, but very little having been found in the free state.

One of the common minerals with which cobalt oxide is associated is a variety of psilomelane, a manganese oxide, known as wad or bog manganese. In certain localities this wad or bog manganese contains considerable cobalt oxide and is then known as asbolite. These minerals all have an iron-black to steel-gray color resembling somewhat a soft amorphous variety of graphite, for which they have occasionally been mistaken.

*Asbolite.*—This mineral is also known as black cobalt, earthy cobalt, and cobalt oxide. Its appearance is as mentioned above and it sometimes contains as high as 32 per cent. of cobalt oxide. In North Carolina none of the sulphides or arsenides, the original metallic minerals of cobalt, have thus far been identified, but in a number of localities the oxide or asbolite has been observed associated with manganese minerals. The principal localities where this asbolite has been found are as follows: A few miles southeast of Cary, Wake County, where black manganese cobalt mineral can be observed for a quarter of a mile outcropping occasionally on the surface. A small amount of prospecting has been done here, consisting of pits and cuts on the vein, which have shown that it is probably continuous for at least a quarter of a mile. In Gaston County there is a belt of micaceous schist extending in a general N. 20° E. direction that can be traced from Bessemer City northeastward into Lincoln County. These schists contain throughout their whole area numerous small seams, incrustations and stains of black manganese materials, which give reactions for cobalt. Some of this material is largely iron oxide that has more of a reddish or yellowish ocher color. At the Ormond iron mine, one mile southwest of Bessemer City, there is a considerable quantity of this material found mixed with the iron ore, and it may be that it was the cobalt which went into the pig-iron, and gave it the

hardness and toughness for which this iron was noted. At the Long Creek gold mine, situated about 6 miles northwest of Dallas, Gaston County, masses of the ore taken out of the Asbury shaft were thickly incrusted with mamillary masses of asbolite or earthy cobalt. About a mile northeast from the Long Creek mine, on the old Lincolnton-Yorkville (S. C.) road, near the summit of Cross or Peysour Mountain, a band of rock, about 15 feet wide, contains veins and seams of wad or asbolite. Following this vein in a northerly direction, it descends the west slope of Cross Mountain, and 50 years ago a number of openings were made on the asbolite seams. Some of this material was analyzed and gave 13.26 per cent of cobalt and nickel oxides, the larger amount being cobalt. The same formation can be traced in Lincoln County, where similar seams of wad are observed. The original minerals from which this cobalt oxide was derived may be one of the sulphides mentioned above, or some of the sulphides that contain both nickel and cobalt.

There are many other localities where psilomelane or wad has been found, but at the present time they have not been shown to contain cobalt. These are Scott's Hill, Burke County; near Lenoir, Caldwell County; at Gillespie, near Bakersville, Mitchell County; on Cove and Richmond creeks, Haywood County; near Buckhorn, Chatham County; near Murphy, Cherokee County; Franklin, Macon County; Webster, Jackson County; Zirconia, Henderson County; and Davidson River, Transylvania County.

The simplest test for cobalt is by fusing some of the powdered mineral with borax, the cobalt oxide giving to the resulting borax glass a deep blue color. This test is so delicate that it will show even traces of cobalt and can be used when a large percentage of nickel is associated with the cobalt.

## IRON.

The iron deposits of North Carolina were not very extensively operated during 1905, and the only deposit that was a producer of this metal was the celebrated Cranberry mine at Cranberry, Mitchell County, which contains magnetic iron ore and furnishes a pig-iron of superior quality. A similar iron ore occurs in Ashe County and only its distance from railroad transportation prevents its being mined. There are other deposits of iron ore throughout the different counties of North Carolina that are not worked, principally on account

of their distance from sources of fuel and flux, or their distance from railroad transportation. There are some deposits, however, favorably situated on the railroad, such as the Ormond mine, Bessemer City, Gaston County, which should make profitable mining, even though the ore has to be shipped a considerable distance by rail. With any advance in the price of iron the deposits in Cherokee, Jackson, Chatham, and Gaston counties would, undoubtedly, be worked, and the ore shipped to furnaces located at Bristol, Tenn., Birmingham, Ala., or elsewhere.

### PRODUCTION.

The production of iron ore in North Carolina during 1905 amounted to 56,282 tons, valued at $70,352, and was obtained from Mitchell County. As compared with the production of 64,347 long tons valued at $79,846, the 1904 production, it is a decrease of 8,065 tons in quantity and of $9,494 in value. The Junaluska Iron Company of Andrews, Cherokee County, which produced a small amount of ore in 1904, reported no production in 1905. In the following table is given the production of iron ore in North Carolina from 1900 to 1905, inclusive.

PRODUCTION OF IRON ORE IN NORTH CAROLINA, 1900-1905.

| YEAR. | AMOUNT LONG TONS. | VALUE. |
|---|---|---|
| 1900 | 21,000 | $42,000 |
| 1901 | 2,578 | 4,997 |
| 1902 | 34,336 | 52,771 |
| 1903 | 82,851 | 78,540 |
| 1904 | 64,347 | 79,846 |
| 1905 | 56,282 | 70,352 |

### TIN.

There was no production of tin ore in North Carolina during 1905, but there was much prospecting and development work carried on, especially at Kings Mountain, Cleveland County; near Bessemer City, Gaston County; and near Lincolnton, Lincoln County. At the old Ledoux mine, at Kings Mountain, a mill with rolls, jigs, and tables was erected, and the company operating this plant expect to handle not only the ores from this mine, but from other tin deposits that are being opened up in the vicinity. A small quantity of con-

centrates have been obtained from this property, but none have been put on the market.

At the Jones mine, 7 miles north of Kings Mountain and 3 miles northwest of Bessemer City, a small roll-mill with two Bartlett tables was erected and a small amount of the ore treated. The concentrates, however, have not been shipped. The property has been worked to the 100-foot level, and some very good ore has been exposed. There has not, however, been any large amount of ore blocked out.

Perhaps the most extensive development work has been carried on near Lincolnton, Lincoln County, by the Piedmont Tin Mining Company. The property of this company begins about 2 miles southwest of Lincolnton and extends in a general southwest direction for 2 miles, to the Little Catawba River, about midway between Long Shoal and South Side, two stations on the Carolina and Northwestern Railroad. Tin-bearing pegmatite has been exposed at a number of places throughout this area, and has shown the existence of two or more approximately parallel pegmatitic dikes, which are also following the laminations of the schists and gneisses. There were other pegmatitic dikes also observed that were cutting the dikes referred to above and the lamination of the country rock. The company have acquired by purchase and lease control of a property about 2 miles long and 1 mile wide, which has been prospected more or less over its entire area.

The country rock of this section consists of hornblende and mica gneisses and schists that are intersected by the pegmatitic dikes, which sometimes are cutting across the strike of the schists and then again following it and at other times have sent off apophyses which have forced their way between the laminations of the schist and gneiss. Occasionally, a mass of the pegmatite is encountered that has all the appearance of a boss. These dikes are very variable in width from a few feet up to 30 or more. They have the usual mineralogical character of ordinary pegmatitic dikes, except that for the most part they are tin-bearing. The position of the tin in these dikes was carefully noted, and in nearly all cases it was observed that the main portion of the dike carried little or no cassiterite (tin oxide), but that this mineral was confined to restricted portions of the dike, which, in nearly all cases, was near the contact of the pegmatitic dike and country rock. In these areas there was usually but little feldspar, and the dike was made up largely of quartz and mica. Occasionally,

where the pegmatitic dike was narrow, tin oxide was found scattered sparingly throughout the whole mass.

The work done by this company has made this section the most favorable one for studying the occurrences of these pegmatitic dikes and of the tin mineral which they contain. Beginning at the southwest end of the property, on a hill, just above the Little Catawba River, the company have sunk shafts and pits and made open cuts at various intervals from this point for a distance of 2 miles in a northeast direction to what is known as the Main Shaft mine, where the greater amount of underground work has been done. Wherever any pegmatitic dikes have been encountered in this prospecting, they have contained more or less tin oxide, but in very varying percentages. The work has also shown that the pegmatitic dikes are extremely variable in width, both on the strike and dip. There are two points, one known as the Henry shaft and the other the Main shaft, where considerable underground work has been done.

The Henry shaft, which is approximately 1 mile southwest of the Main shaft, is 60 feet deep, from the bottom of which a drift 30 feet long has been run in a N. 45° E. direction. In a distance of 18 feet this drift encountered a pegmatitic dike which proved to be 12 feet wide and had an approximate strike of N. 25° W. The main portion of this dike showed little or no tin oxide, but near its contact with the country rock tin oxide was encountered for a width of 1 to 2 feet. At the 45-foot level about 52 feet of drift has been run, which only showed a small amount of pegmatite at one point in the roof of the drift about 12 feet from the shaft.

At the Main Shaft mine, where most of the work of the company has been concentrated, two shafts have been sunk, one 102 feet deep and the other, which is 165 feet E. 12° S. from No. 1, is 40 feet deep, the two being connected on the 40-foot level. Near the mouth of the 40-foot shaft a pegmatitic dike was encountered near the surface and was followed on the surface for some distance in each direction by an open cut. In sinking this shaft pegmatite was encountered for only a part of its depth, and the foot of the shaft is entirely in the country rock. As far as can be determined, the pegmatite encountered in the shaft is simply an apophysis from the mass of pegmatite encountered on the surface, or else a small parallel dike. The 102-foot shaft has two levels, one at 40 feet and the other at 102 feet. From the 40-foot level the main drift is 198 feet 8 inches long and

extending beyond the 40-foot shaft. From this drift cross-cuts aggregating 720 feet have been made. The larger proportion of the work done on this level is entirely within the country rock, and the crosscuts are very circuitous in their courses. They have proved that the pegmatitic dikes, of which there are evidently a number, are irregular in their course and vary considerably in width, both along the strike and dip. A large portion of the drifts and crosscuts on this 40-foot level are entirely within the country rock and is partly due to the irregularity of the pegmatitic dikes. At a number of points throughout the crosscuts and drifts on this level, winzes have been sunk in some instances on a pegmatitic dike and in others to encounter a supposed one that was dipping under the drift or crosscut. These winzes aggregate 67 feet of depth, making a total of 1,177 feet of development work on this level.

From the bottom of the shaft on the 102-foot level drifts have been run east and west for a distance of 158 feet, from which 33 feet of crosscuts have been made, making a total of 191 feet of development work on this level. A pegmatitic dike a few feet in width was encountered in the west drift, which was followed by the crosscuts.

There has been a total of 1,319 feet of underground development work at this Main Shaft mine, and although this has exposed in a number of places pegmatitic dikes which carry more or less tin, it has not as yet developed or blocked out any large quantity of ore. The dikes show the same characteristics regarding the tin oxide as was observed in those examined on other parts of the property, namely, that the larger proportion of the tin oxide is concentrated near the contact of the pegmatitic dike with the country rock and usually in seams from a few inches to a foot in width.

Although there has been this comparatively large amount of work accomplished during the past year on the tin deposits of the State, it has not as yet proved conclusively the real value of the Carolina tin deposits. It has, however, demonstrated that to make these deposits profitable will require economical and careful management. The work has also shown that the percentage of tin in the narrow portion of the pegmatitic dikes, near the country rock, will run rather high, perhaps as much as 4 to 8 per cent of tin oxide; but as this portion of the dike will vary from a few inches to possibly 2 feet, it will reduce the percentage of tin oxide in the rock necessary to remove in mining to from a fraction of one per cent to perhaps 1½ per cent

tin oxide. Although these percentages of tin oxide in the vein are small, yet with careful management and tin at 30 cents per pound, they could be worked at a profit. With tin at the price it has been selling for during the past year, 48 cents, the chances of profit are, of course, much larger.

Tin mining is a very attractive mining proposition, on account of the scarcity of the metal and the large demand for it in the United States, which imported during 1905, 44,188 short tons valued at $26,316,023, making an average price of 29.77 cents per pound. This is considerably below the price at which tin was sold in New York City during the year, which, to the middle of December, 1905, had reached 37⅜ cents per pound. During the early part of 1906 it had reached 48½ cents per pound. The reason for this rise in the price of tin has been that the consumption is largely in excess of the present supply, and stocks of tin that have been kept on hand have been consequently very materially diminished.

Although these high prices have stimulated prospecting for new sources of supply of tin ore, they have not resulted in locating any deposits capable of producing large quantities of this metal.

It is to be hoped that the future development work on the tin deposits in the Carolinas will be carried on in such a way as to block out bodies of ore which can be carefully sampled and their tin contents determined and a satisfactory method devised for saving the tin concentrates, provided the percentage of the tin mineral is high enough to warrant their being worked.

## ABRASIVE MATERIAL.

The abrasive industry in North Carolina is not large, and since the closing down of the corundum mine at Cullasaja, Macon County, and the garnet mines at Sugar Loaf Mountain, Jackson County, the production of abrasives has been very small.

### CORUNDUM.

Although there is a large demand for corundum, which the present supply does not begin to fill, yet there has been but very little activity in corundum mining in this State during the past year. One reason for this inactivity is the fact that the International Emery and Corundum Company of New York own three or four of the better

corundum properties in the State, including the Corundum Hill and Mincey mines, Macon County, and the Buck Creek mine, Clay County. This company has not worked any of these properties since they came into their possession and, as far as can be learned, has no intention of working them, but will sell same if a satisfactory price can be obtained. On account, however, of the length of time since these properties were operated, no purchaser would be justified in paying any large amount for these properties without first having obtained an option which would give sufficient time to open them up and find out their present condition. There is, undoubtedly, still a large quantity of good corundum in the Corundum Hill and Buck Creek properties, which, if mined and cleaned properly, would find a ready sale.

The only two properties that are being actively operated are in Clay County, one being the old Behr mine located in Clay County, near Elf P. O., on Shooting Creek, 6 miles southwest of Haysville, the county-seat. The nearest railroad point is Murphy, Cherokee County, which is 26 miles northwest of this mine. It was first opened in 1880 by Dr. H. S. Lucas, but was soon afterwards bought by Herman Behr & Co., of New York. Several car-loads of cleaned corundum are reported to have been shipped, but the mine remained closed from 1890, until it was reopened during the past year by Major H. P. Dunlap of Asheville, N. C. The corundum has been opened in a mass of peridotite rock, which can be traced for a distance of a little over 2 miles in a N. E.-S. W. direction, and near the northeast extension of this long narrow mass of peridotite. The main mass of this rock, which has a maximum width of a quarter of a mile, is one-half mile southwest of the Behr mine. Cutting this peridotite are dikes of dark-green amphibolite. The main country rock through which these two rocks have penetrated is a hornblende-gneiss. Corundum has been found sparingly at a number of places in the mass of peridotite, but usually close to its contact with the gneiss. It has also been found in certain portions of the amphibolite. At the present time the work that has been done on this corundum deposit consists of a large oval-shaped cut or pit approximately 80 feet long, 36 feet wide and 45 feet deep. From the bottom of this pit an inclined (60°) shaft has been sunk to a depth of 30 feet, from the bottom of which drifts were run N. E. and S. W. At a depth of about 40 feet the corundum and peridotite were found to dip under the hornblende-gneiss at an angle

of 60°, and conditions seem to indicate that a small block of gneiss has been enclosed by the peridotite, which may have influenced the greater separation of corundum at this particular point. Thirty-six feet northwest of the inclined shaft is a vertical shaft started from the surface which has been sunk to a depth of 90 feet. At the 75-foot level a drift was run S. E., encountering, in a distance of 30 feet, the corundum vein which had been worked in the old inclined shaft. The bottom of this 90-foot shaft, which could not be seen on account of its containing water, was reported as still being in barren peridotite rock. The old drifts from the incline were so badly caved in that it was impossible to re-examine them. The vein, however, where it was cut by the drift from the vertical shaft was examined, as was also all sides of the open cut and pit, but only a small amount of corundum was observed This property is still being worked and giving employment to about six men.

To the north of the Behr mine, and across the mountain, is one of the most important corundum localities in North Carolina, which is known as the Buck Creek region, where the corundum is associated with the largest compact peridotite area in the State. The locality is in the narrow Buck Creek valley, about 20 miles southwest of Franklin, Macon County, and 21 miles northeast of Haysville, Clay County. The property, which includes the main mass of this peridotite formation, is owned by the International Emery and Corundum Company of New York, referred to above.

Near the northwestern end of this peridotite mass, where it is much narrower than the main mass, is the mine of the North Carolina Corundum Company, of Detroit, Michigan. The corundum has been found in a number of small veins of almost massive corundum, 3 to 6 inches thick. The company has erected a large mill for cleaning the corundum and a small amount of the cleaned product has been shipped. The property has not been operated very extensively during 1905, and for a considerable part of the year was shut down.

There has recently been published by the Survey a volume* on Corundum and the Peridotites of Western North Carolina, by Joseph Hyde Pratt and Joseph Volney Lewis, of which the following is a short review.†

*Copies of this volume can be obtained by writing Joseph Hyde Pratt, State Geologist, Chapel Hill, N. C., and enclosing 35 cents for postage, or 75 cents if a cloth-bound copy is desired.

†Journal of the Elisha Mitchell Sci. Soc., Vol. 22, 1906, p. 8.

Under the above title, Volume I of the North Carolina Geological and Economic Survey Reports has recently appeared. The scope of the work, however, is broader in many ways than this title indicates. It is a volume of 464 pages, and is illustrated by 45 plates and 35 figures in the text. While the report is the result of collaboration, the work has been divided so that, in the main, the mineralogical investigations have been conducted by Dr. Pratt, and the petrographical study of associated rocks has been the work of Professor Lewis. The preface states: "To only a limited extent have the authors been able to carry on field work together. The work for the most part has been done at different times, each working independently. Notwithstanding this fact and the somewhat different methods employed, each has been led to essentially the same conclusions in the interpretation of field observations. Especially is this true in regard to the theories of the origin and present relations of both the peridotites and the corundum."

A brief sketch of Geology of the State is given in Chapter I, with a somewhat fuller description of the belt of gneiss, granites and schists, constituting the mountain section of the west, and in which the peridotites and the corundum deposits of the State occur.

Chapter II deals with the peridotites and associated basic magnesian rocks, including four varieties of peridotites, four pyroxenites, four gabbroic rocks, an amphibolite, and three varieties of diorite. These are chiefly well-known types, with the exception of the pyroxenite, composed of the orthorhombic pyroxene, enstatite. This rock is somewhat commonly found throughout the region and forms many masses of considerable extent. The name *enstatolite* is proposed for this type, in conformity with the terms bronzitite and hypersthenite. These rocks are discussed in their relations to the belt of similar rocks, which extends the whole length of the eastern crystalline belt, from central Alabama through Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, the New England States, Quebec and Newfoundland.

Maps are given showing the distribution and relations of these rocks to the crystalline rocks in eastern North America and western North Carolina, besides several detailed maps of various portions of the belt of particular interest. The contoured map of western North Carolina is on a scale of eight miles to the inch, with the base printed in three colors, after the manner of the maps of the United

States Geological Survey. On this the "Conglomerates, quartzites, slates, etc., chiefly 'Ocoee,' correlated with Cambrian by the United States Geological Survey," and the "Gneisses, schists, granite, diorites, and other crystalline rocks of pre-Cambrian age," are clearly represented by tints, while the numerous dikes of peridotites and related rocks and the occurrences of corundum, chromite and asbestos, are shown in bright red.

The petrographic descriptions which constitute Chapter III are illustrated by half-tone reproductions of photomicrographs, showing the mineralogic and structural variations and modes of alteration of the rocks described. Following the general descriptions of these rocks throughout the Appalachian region, the distribution and petrographic characters are given in considerable detail for western North Carolina.

In addition to the numerous facies of primary rocks, secondary types are also described, including those mechanically derived from the primary types, now represented by gneisses, schists and gabbro-diorite, and also a series of hydrous alteration products, including serpentine, steatite, and chloritite (chlorite rock). The vast majority of occurrences of these basic rocks, while showing more or less alteration, are essentially fresh primary types, especially the pure olivine-rock, dunite, which is much the most common. Steatite is pretty widely distributed as an alteration product, but massive serpentine is almost entirely confined to an area extending about 15 miles north and south of the French Broad River. Even in these cases, however, the origin of the serpentine from peridotites of exactly similar character to those found in adjoining regions is very evident.

Chapter IV takes up the modes of alteration and decomposition of the peridotites, and five distinct processes are recognized: 1. Weathering; 2. Serpentinization; 3. Steatitization; 4. Chlorotitization; 5. Amphibolization. The processes of weathering and serpentinization are well-nigh universal, though developed only to a slight extent, except in a few localities. Alterations to talc, chlorite and amphibole are much more limited in their manifestations, but have given rise to many important rock masses. The various processes as affecting the peridotites of diverse composition are described minutely.

The long-vexed question of the origin of peridotites is taken up in Chapter V. The strong trend of modern thought toward the th[illegible]

of igneous origin is clearly brought out, and the correctness of this theory is abundantly substantiated by observations in North Carolina. The data presented upon this point are arranged under five heads: 1. Mineralogic characters; 2. Microscopic characters; 3. Gross structures; 4. Modes of occurrence; 5. Relation to the gneisses and schists. This is followed by a discussion of the general petrology of the peridotites and associated rocks in which the conception of genetic unity of the whole series is strongly emphasized.

It is pointed out, as a noteworthy fact, that many of these rock types are closely associated in almost every occurrence throughout the crystalline belt of eastern North America. Usually, one or another type preponderates in any particular region, but the associations are always essentially the same. Thus the peridotites, particularly dunite, prevail in North Carolina and Quebec, the pyroxenites in Pennsylvania, and the gabbros are very abundant in Delaware and Maryland. In fact the types represented in the various regions are almost identical, and the petrology is closely similar, except in relative abundance of the various types, and in degree of alteration.

In discussing the magmatic relations of the peridotites, anorthosites, amphibolites, etc., two generations of corundum are recognized. The greater part, including all deposits of commercial value, belongs to the first generation, and was formed by the crystallization of the excess of alumina in the original peridotite magma. A very small part, however, occurring in microscopic grains, has been produced by an excess of alumina arising from the corrosion of anorthite by the still molten magnesia magma. This process has produced the sheaths of intermediate minerals which form the *corrosion mantles,* so beautifully developed in some localities, or which, in some cases, entirely replace the anorthite or the olivine, as the case may be, with nest-like aggregates.

Regarding the age of the peridotites, the conclusion of the present writers may be summarized as follows: Sufficient data are not yet available for a satisfactory determination of the age of these rocks, but their intrusion was probably contemporaneous, or practically so, for the whole region from Newfoundland to Alabama. The peridotite belt lies in a region of great disturbance and intense metamorphism. This fact, together with the geological relations to the northward, suggests the hypothesis that the principal period of intrusion was closely associated with the orogenic movements which closed

the Lower Silurian (Ordovician) period. The distribution of these rocks may well mark to a great extent the axis of most intent folding and faulting. The latter Appalachian disturbances, at the close of the Carboniferous, have produced the lamination so often seen in these rocks, and have probably given occasion for later minor intrusions. This hypothesis is not offered as a final answer to the question of age of the peridotites. Much painstaking work yet remains to be done before an entirely satisfactory solution of this problem can be expected.

The chapter closes with a discussion of the relations of the secondary rocks, in which the attempt is made to trace the various laminated and hydrated alteration products back to their original types. Here the question is reached, whether the amphibolites, diorites, hornblende-schists, and hornblende-gneisses may not themselves have been derived from corresponding pyroxenite types, such as are met with in the Maryland and Delaware gabbro areas. The fact is pointed out that undoubted gabbro-diorites do exist in portions of the belt in North Carolina, and hence it is considered probable that many, if not all of these rocks, as well as similar rocks throughout the region, have had a like origin.

After a discussion of the physical and chemical properties of corundum in Chapter VI, is given a description of the various applications of the mineral in the arts, and an outline of the process of manufacture of the several types of corundum and emery wheels on the market.

Chapter VII deals with the modes of occurrence of corundum. In North Carolina the mineral is known in five types of igneous rock, namely, peridotite, pyroxenite, amphibolite, anorthosite, and pegmatite; in six metamorphic rocks, serpentine, gneiss, mica-schist, quartz-schist, amphibole-schist, and chlorite-schist. It is also found in gravel deposits of emery, whose relations are undetermined. These modes of occurrence are described in detail, and are compared with similar occurrences, when known, in other parts of the world. The deposits which have been of chief commercial importance in North Carolina have been associated with peridotites, and to a less extent with pyroxenites and amphibolites. The gravel deposits are of considerable interest on account of the corundum gems (ruby) and associated garnet gems (rhodolite) that have been found in some of them.

With the peridotites the corundum occurs chiefly in "peripheral or border veins," striking along the borders of many of the massive outcrops, and in "interior veins," extending from the borders at greater or less distance toward the center of the peridotite masses. In the pyroxenite and certain of the amphibolite occurrences the mode is similar. In other amphibolites the corundum is irregularly distributed in grains and larger plates and nodules through portions of the rock. Certain small pegmatite dikes, accompanying and penetrating both the peridotite and amphibolite, are found also to carry corundum. The corundum-bearing serpentine, amphibolites, and chlorite-schists are simply alterations of some of the foregoing types, with more or less dynamic disturbances and rearrangement of materials. Corundum-bearing belts of the gneisses and mica-schists, which sometimes pass into quartz-schists, have no apparent or probable relation with the peridotites, although occurring in the same region, and in some cases near the outcrops of these rocks.

The chief localities of corundum-bearing peridotite are in Clay, Macon, and Jackson counties, in the southwestern corner of the State, and most of the corundum-bearing gneisses, etc., are also found in the same counties. Certain scattered occurrences of corundum in amphibolite dikes and also in the gneisses are found east of the mountains, particularly in Iredell County.

"Other occurrences of corundum in America" extends the list of corundum-bearing igneous rocks to include granite, syenite, nephelinesyenite, Plumasite, norite, andesite, and monchiquite and adds crystalline limestone to the list of metamorphic corundum-bearing rocks. A brief description of each of these modes of occurrence is given with references to the literature of those that have been previously described. An additional list of "Modes of occurrence of corundum not found in America" adds to the number of corundum-bearing igneous rocks, kyschtmite tonalate, gabbro, quartz-porphyry, trachyte, and basalt, besides contact-zones and inclusions in igneous rocks. To the metamorphic list are added corundum schists and porphyroids and graphite. These are followed in turn by brief descriptions, completing the list to date of all known modes of occurrence of corundum throughout the world.

The distribution of corundum is described in Chapter VIII. Like the peridotites, this is treated first with reference to the Appalachian belt as a whole, noting the occurrences in Alabama, Georgia, South

Carolina, North Carolina, Pennsylvania, New Jersey, Connecticut, and Massachusetts. Corundum in the western part of the country includes descriptions of occurrences thus far known in Montana, Colorado, and California. This is followed by a description of the North Carolina localities in detail, arranged by counties, beginning in the southwestern corner of the State. The chapter closes with the description of foreign corundum and emery deposits, including those of Canada, India, Turkey, and the Grecian Archipelago.

Chapter IX deals with the alteration of corundum and its associated minerals in great detail. The list of minerals found associated with corundum in North Carolina includes 62 species, each of which is described, with its mode of occurrence, and its relations to the occurrence of corundum. Many have chemical analyses and crystallographic characters also given. "Minerals associated with corundum not found in North Carolina" adds 12 more to this list, from various American and foreign localities.

The difficult question of the origin of corundum is discussed in Chapter X. This is prefaced by an account of the artificial production of corundum, and the origin of corundum in nature is introduced by a sketch of the various hypotheses that have been proposed during the last quarter of a century. After a discussion of the field relations and the later experiments in the production of artificial corundum, the conclusion is reached that the corundum was held in solution in the molten magma of the peridotite when it was intruded into the country rocks, and that it separated out among the first minerals segregated as the mass began to cool. The conclusion is also reached that the corundum in the quartz-schists and gneisses is the result of metamorphism of sandstones and shales, some of which were rich in alumina, perhaps in the form of bauxite, which, during metamorphism, crystallized out as corundum.

Chapter XI deals with corundum mining and milling. It is introduced by a historical sketch of corundum mining in the East, followed by a sketch of mining in America. "Suggestions to prospectors," and methods of mining and milling, as carried out at various plants, conclude the chapter.

Chapter XII discusses the chromite and other economic minerals of the corundum-peridotite belt. Chromite in promising quantities has been found at a number of the peridotite localities in western North Carolina, particularly in Jackson and Yancey counties. Its

origin and relations are discussed and the conclusion reached is essentially the same as for the origin of corundum in peridotites. A discussion of the chemical composition of chromite and its uses, and a description of the chromite localities of the region, with a summary of occurrence in other parts of the world, follow. The distribution and character of asbestos, nickel ores, serpentine, and limonite—minerals which, thus far, are of minor importance in the region—closes the chapter.

An appendix, consisting of a bibliography of American peridotites, and corundum and associated minerals, is not complete, perhaps, as regards the whole of North America, but is believed to be practically complete for North Carolina and the eastern crystalline region in general. There are also many references to foreign literature in foot-notes throughout the work, and the volume is closed with an elaborate index.

## GARNET.

The demand for garnet for abrasive purposes is not very large, and the total amount produced in the United States since 1900 has varied from approximately 3,200 to 5,000 tons per year. There are many localities in North Carolina where garnet occurs in commercial quantity, but some of these are non-productive, on account of their distance from railroad transportation; others, which were formerly productive mines, have been shut down, but for what cause it is not known. The Sugar Loaf mine in Jackson County produced a quality of garnet for which there was considerable demand at a price higher than that paid for any other garnet on the market. The cost of production of this garnet was somewhat in excess of preparing most garnet, but the quantity of raw material is large and it could be put on the market in most any quantity desired. This property, however, was not operated at all during 1905.

The garnet deposit on Little Pine Creek, near Marshall, Madison County, produced a small amount during the past year.

A new, though small, source of supply of this mineral should be the garnet sand separated from the monazite concentrates obtained in mining this latter mineral in Burke, Iredell, Cleveland, and other counties in North Carolina. These concentrates sometimes contain as much as 20 per cent or more of garnet which is in the form of grain that has been rounded but very little, often having the appearance as though it has been crushed. A very clean separation of the

garnet from the other minerals can be made on the Wetherill magnetic separator, and, as this mineral would be a by-product, it could readily compete with any garnet on the market. The product would be of exceptional purity and the garnet would have a hardness equal to any garnet that is now being mined.

### MILLSTONES.

Buhrstones, or millstones, are usually manufactured from a stone that varies from a sandstone to a quartz conglomerate. In North Carolina, however, buhrstones are being made from a granitic rock which occurs at Faith, Rowan County, and thus far wherever used have given perfect satisfaction. The general demand for millstones or buhrstones has been increasing during the past few years for use in grinding cereals, mineral paint ores, fertilizers, cement rock, barytes and other minerals, and for these purposes the Rowan stone should give good satisfaction. There was, however, a falling off in the production of millstones in 1905.

### PRODUCTION OF ABRASIVES.

There were only five producers of abrasive materials in North Carolina. Of these, three were millstones and one each of garnet and corundum. The combined production of garnet and corundum in 1905 amounted to 115 tons, valued at $9,000, as compared with 202 tons, valued at $6,586, in 1904. This shows a decrease of 87 tons in quantity, but an increase of $2,414 in value. This is due to the larger quantity of corundum mined in 1905 as compared with that of 1904, and a very large decrease in the quantity of garnet sold. There were 196 pairs of millstones valued at only $2,652 produced in 1905, as compared with 208 pairs valued at $6,500 in 1904. The quantity produced in these two years is almost equal, but the value of the 1904 production is over twice that of the 1905 production, due to the lower price of millstones and to the larger number of smaller stones made as compared with the previous year.

The total value of all abrasive materials produced in 1905 is $11,652 as compared with $13,086, the value of the 1904 production, a decrease of $1,434. The production of abrasive materials from 1901 to 1905 inclusive is given in the following table.

PRODUCTION OF ABRASIVE MATERIALS, 1901-1905.

| YEAR. | CORUNDUM. | | GARNET. | | MILLSTONES. | | TOTAL VALUE. |
|---|---|---|---|---|---|---|---|
| | QUANTITY. | VALUE. | QUANTITY. | VALUE. | QUANTITY. | VALUE. | |
| | *Tons.* | | *Tons.* | | *Pairs.* | | |
| 1901 | 325 | $ 48,840 | 775 | $ 43,000 | ---------- | $ ---------- | $ 91,840 |
| 1902 | ---------- | ---------- | 260 | 10,040 | 50 | 1,425 | 11,465 |
| 1903 | ---------- | ---------- | *403 | 12,250 | 63 | 902 | 13,152 |
| 1904 | ---------- | ---------- | *202 | 6,586 | 208 | 6,500 | 13,086 |
| 1905 | †1,150 | 9,000 | ---------- | ---------- | 196 | 2,652 | 11,652 |

## MICA.‡

### PRODUCTION.

Mica is one of the minerals for which North Carolina is especially noted, and of the total production of this mineral in the United States, North Carolina produces approximately four-fifths of the entire production. North Carolina mica is known as the standard mica and is the finest grade of mica on the market, and for those purposes where a sheet mica is desired, as for stoves, lamp-chimneys, etc., it cannot be surpassed. During 1905 the production of plate or sheet mica was 1,044,800 pounds valued at $100,900, this being an increase of 434,679 pounds in quantity, but only of $276 in value as compared with the production of 610,121 pounds valued at $100,724 in 1904. This large increase in the quantity of mica produced, with comparatively no increase in the value, is due to the much larger production of small disks and rectangular sheets that are used so largely for electrical purposes. The scrap mica produced in 1905 amounted to 275 tons valued at $3,375, an average of $12.27 per ton. As compared with the production of 1904, of 341 tons valued at $3,410, this is a decrease of 66 tons in quantity, and of $35 in value. There is given in the following table the approximate value and distribution of the production of sheet mica by counties for the years 1900 to 1905 inclusive.

* Including production of corundum.

† Including production of garnet.

‡ For a more detailed discussion of mica, see reports for 1901 and 1904, Economic Papers 6 and 9 respectively.

PRODUCTION OF MICA IN NORTH CAROLINA DURING 1900 TO 1905, BY COUNTIES.

| County. | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. |
|---|---|---|---|---|---|---|
| Ashe | $---------- | $---------- | $---------- | $ 1,000 | $---------- | $---------- |
| Buncombe | ---------- | ---------- | 250 | 300 | ---------- | ---------- |
| Caldwell | ---------- | ---------- | ---------- | ---------- | 10,000 | ---------- |
| Haywood | 11,000 | 11,500 | 20,000 | 18,000 | 34,500 | 33,710 |
| Jackson | 7,000 | 8,740 | 5,700 | 5,500 | 924 | 7,900 |
| McDowell | 1,000 | 500 | 600 | 1,000 | ---------- | ---------- |
| Macon | 5,200 | ---------- | 4,000 | 3,500 | ---------- | 1,500 |
| Madison | ---------- | ---------- | ---------- | ---------- | ---------- | 90 |
| Mitchell | 26,722 | 33,506 | 28,203 | 29,000 | 21,500 | 17,950 |
| Stokes | 1,000 | ---------- | 1,000 | 7,500 | ---------- | ---------- |
| Transylvania | 500 | 600 | 750 | 500 | ---------- | 600 |
| Watauga | ---------- | ---------- | ---------- | ---------- | ---------- | 350 |
| Yancey | 12,788 | 25,003 | 21,150 | 20,000 | 34,000 | 38,800 |
| Total | 65,200 | 79,849 | 81,653 | 86,300 | 100,724 | 100,900 |

## QUARTZ (FLINT).

The quartz considered under this head is vein quartz, which is used for a variety of purposes, such as in the manufacture of pottery, for packing, for fluxing purposes, as an abrasive material, manufacture of scouring soaps, as a wood-filler, and in the manufacture of glass. In North Carolina the only flint that has been mined has been for fluxing and packing purposes.

During 1905 quartz was mined in Cherokee County for fluxing purposes, being used by the Tennessee Copper Company in their copper furnaces at Ducktown, Tenn. The Oliver mine in Mecklenburg County produced considerable quartz which was used for packing purposes. With the establishment of potteries in North Carolina there should be a considerable demand for quartz to be used for this purpose. Besides the above quartz, there is a great deal of quartz sand that is used in the manufacture of brick and other clay products, which, however, is not treated under this head, but is taken up under the head of Sand.

### PRODUCTION.

The total production of quartz during 1905 was 32,648 tons valued at $13,659 as compared with 32,972 tons valued at $36,269, the production of 1904. This is a decrease of 324 tons in quantity and of $22,610 in value. This large falling off in value is due to the low value accredited to the production from Cherokee County used for fluxing purposes. This value was but little over 30 cents per ton. In the table below is given the production of quartz in North Carolina for the years 1901 to 1905 inclusive.

PRODUCTION OF QUARTZ IN NORTH CAROLINA, 1901-1905.

| YEAR. | QUANTITY. | VALUE. |
|---|---|---|
| | *Tons.* | |
| 1901 | 3,000 | $ 7,500 |
| 1902 | 4,500 | 11,250 |
| 1903 | 29,462 | 36,827 |
| 1904 | 32,972 | 36,269 |
| 1905 | 32,648 | 13,659 |

## BARYTES.

### PRODUCTION.

The production of crude barytes in North Carolina during 1905 amounted to 5,544 tons valued at $21,670. This production is a decrease of 7,869 short tons in quantity and of $12,260 in value as compared with 13,413 short tons valued at $33,930, the production of 1904. The average value per ton received for the 1905 production was $3.91, which is $1.38 more than the average value, $2.53 per ton, of the 1904 production. The value received for the North Carolina barytes represents the crude mineral that has been mined and handcobbed ready for shipment to the mill, but without its being subjected to any other cleaning process. This production was obtained from Madison and Gaston counties, with by far the larger amount from the former county. In the following table there is given the production of barytes in North Carolina for the years 1901 to 1905 inclusive:

PRODUCTION OF CRUDE BARYTES IN NORTH CAROLINA, 1901-1905.

| YEAR. | QUANTITY, SHORT TON. | VALUE. |
|---|---|---|
| 1901 | 6,890 | $20,865 |
| 1902 | 14,679 | 44,130 |
| 1903 | 6,835 | 21,347 |
| 1904 | 13,413 | 33,930 |
| 1905 | 5,545 | 21,670 |

## MONAZITE AND ZIRCON.*

### INTRODUCTION.

During the past five years there has been a considerable advance made in the manufacture of various forms of apparatus for lighting purposes. These investigations and inventions have led to the practical introduction of certain metals and metallic oxides into the arts which before this time had little or no commercial value. With the demand for these metals and metallic oxides there at once arose the question of their sources of supply, which has resulted in the mining of a number of minerals that were formerly supposed to be extremely rare in their occurrence, but which have now been found in considerable quantity. Experiments are being carried on with still other metals in regard to their usefulness for the manufacture of various incandescent and electric lamps.

The metals and the metallic oxides that are now being used and experimented with are tantalum, tungsten, cadmium, zirconia, thoria, yttria, and cerium, lanthanum, and didymium oxides. With the exception of cadmium, all these materials are being used commercially in the manufacture of different lamps and are obtained from the following minerals: Monazite, zircon, gadolinite, columbite, tantalite, wolframite, and hübnerite. These minerals and their occurrences have been described in detail in the reports for 1903 and 1904. The use of cadmium for lighting purposes is still in the experimental stage, and, although cadmium lamps have been made, they are still principally of scientific interest. As far as is known, no cadmium lamp has been made that would have a practical commercial value.

Of these minerals that now have a commercial value, monazite, zircon, and columbite have been found in North Carolina, and the two former are at the present time found in greater quantity in this State than in any other.

### MONAZITE.

The demand for the mineral monazite, which contains the oxides used in the manufacture of mantles for the Welsbach and other incandescent gaslights, is constantly increasing, and many inquiries have been received during the past year for information regarding the source of supply of this mineral, not only for domestic, but also for

*U. S. Geological Survey, pamphlet Mineral Resources, 1905.

foreign consumption. Although monazite has been found sparingly at many localities throughout the United States, the Carolinas are still the only States that are producing this mineral commercially; and by far the larger amount is produced in North Carolina. During 1905, however, a probable new source of supply of this mineral has been worked out by the investigations that have been carried on at the concentrating plant of the United States Geological Survey at Portland, Oregon, which has been testing systematically the black sands of the Pacific slope as to their mineralogical contents. The results of this investigation have shown the presence of some monazite and more zircon in many of these sands, especially in those from Oregon and Idaho. By using the Wetherill magnetic separator an almost perfect separation can be made of both the zircon and monazite. The results of this investigation of the black sands will be published in detail as a bulletin of the United States Geological Survey and will give the various localities where monazite has been found in the sands, and its percentage.

In the Carolinas the monazite districts have been pretty thoroughly bounded, but occasionally a new section is discovered showing a sufficient quantity of monazite to make mining profitable, and thus extending the boundary slightly. In Greenville County, S. C., in the vicinity of Lenneman, in Grove Township, considerable monazite has been found in the creeks and branches, and during the past year some of this material has been shipped.

An interesting occurrence of monazite has been found in Queensland.* It has been known for some time that monazite occurs sparingly in the beach sands on the coast of Queensland, and that probably the most promising deposits are near the mouths of the Tweed and the Johnstone rivers. These deposits have not as yet been proved to contain this mineral in commercial quantities. The finding, however, of the monazite in these sands has led to further search which resulted in locating monazite in the original rock in two localities, namely, the Walsh and the Tinaroo mineral fields. Regarding these Mr. Dunstan says:

> The monazite was observed to occur in pure crystalline masses, sometimes several pounds in weight, and also in small cleavable grains. Both forms are irregularly disseminated in quartz, black mica (biotite), and chlorite mica, and are in association with wolframite, molybdenite, scheelite, tinstone, and mispickel.

*Dunstan, B., Acting Government Geologist, Mining World, August 26, 1905.

With the exception of wolframite, these associated minerals are only in comparatively small quantities. The deposits containing the monazite are in granite country, but close to quartz-porphyry and slate. In the granite, and also at the junction of this rock with the porphyry and slate, irregular masses of greisen have been formed from the alteration of the granite, and it is in this, following closely the behavior of the wolframite, that the monazite deposits are to be found.

It is not improbable that the monazite in these deposits may become of commercial value, especially as it could be obtained as a by-product in mining the wolframite ore.

An interesting mineral, thorianite, was discovered early in 1905, associated with corundum, zircon, tin, topaz, spinel, etc. The mineral was first found by Mr. W. D. Holland in the refuse from gem washing near Balangoda, Ceylon, and was supposed to be uraninite or pitchblende, but upon analysis it was found to contain a very large percentage of thoria. The analysis of the mineral is as follows:*

*Analysis of Thorianite.*

| | |
|---|---|
| Thorium oxide | 76.22 |
| Cerium, lanthanum, and didymium oxides | 8.04 |
| Zirconium oxide | Trace. |
| Uranium oxide | 12.33 |
| Ferric oxide | .35 |
| Lead oxide | 2.87 |
| Silica | .12 |
| | 99.93 |

The specific gravity of the mineral is given as 9.32, and it was observed in black cubical crystals, which are fairly hard and give a brown streak. According to Mr. W. F. Peterd† the powdered thorianite dissolves readily in dilute sulphuric as well as in nitric acid. It has also been shown to be highly radio-active because of its uranium contents.

It is not improbable that this new mineral may be found in certain localities, in North Carolina, where tin, topaz, zircon, and monazite are found. According to the reports on this mineral, it is one that could be more easily utilized as a source of thoria than monazite, and as it has a much higher percentage of this compound it would be much more valuable.

* Dunstan, Wyndham R., Ceylon Mineral Survey No. III; Mining Engineering (London), March, 1905, and Min. Mag., May, 1905.

† Min. World, Sept. 16, 1905.

In view of the large increase in the production of monazite in 1905 as compared with that of 1904, of the new companies organized that require thoria in their manufactured products, and of the inquiries that have been received from abroad, any deposit that contains monazite or any other thoria mineral in apparent quantity is worthy of careful investigation.

## TANTALUM MINERALS.

The tantalum minerals are in demand on account of their containing the metal tantalum, which is used at the present time only in the manufacture of very fine wire for use in the construction of what is known as the tantalum lamp. Both the occurrences of the tantalum minerals and the tantalum lamp were described in detail in the report for 1904, and much has been written regarding the lamp in various scientific and commercial magazines during 1905, indicating its successful commercial use. In a recent paper read at the electrical convention in Denver and published in part in the *American Inventor*,* Dr. Louis Bell makes the following statements regarding the value of this lamp:

> The mean result of various tests of lamps were: From clear globes, 22.2 candlepowder at 1.85 watts per candlepower, and from frosted globes, 19.08 candlepower at 2.1 watts per candle. It is interesting to note that the clear lamp gives just about one candlepower per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 candlepower per square inch of filament—a figure much higher than in the ordinary incandescent. As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator. Putting aside all the petty questions that will be raised about the new lamp for commercial reasons, the broad fact remains that we are here dealing with a *bona fide* 2-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these, socket by socket, and not as a substitute, with particular requirements, as in the case of the Nernst lamp, or the very small arcs. There is some doubt as to the life of the tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the every-day work of the central station there is good reason to believe it generally applicable.
>
> Its price can hardly be said to be fixed in this country, but abroad, in Berlin, it is about $1 (four marks), which will give at least a fair line on its commercial results. On this basis, and with power at 10 cents per kilowatt-hour, one finds, taking the new lamp on its 600-hour rating, that the cost of its 12,000 candle hours, including the lamp, amounts to $3.40. The same number of candle hours from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90,

* American Inventor, July, 1905.

exclusive of lamps; that is, the consumer could afford to pay $1 for the new lamp better than to take the old ones free. With power as low as 5 cents per kilowatt-hour, the user of tantalum lamps could afford to pay only 75 cents per lamp, as against getting carbon lamps free. This means that a sliding scale of discounts for lamps according to quality could be made to catch the consumer at all prices ordinarily charged for current by central stations.

The writer has examined a number of tantalum lamps and used some for a short time. The light is nearly white, like the Nernst or the acetylene light, and quite agreeable, though it will usually be found too bright unless a ground glass or frosted globe is used. It was noticed that there was more or less tendency for the tantalum filament to snap or break when subjected to an unusually great vibration, especially after the lamp had been used for some time. This difficulty, however, will very probably be overcome with further experiments as the lamp is more fully perfected. As yet it has not been introduced to any great extent in this country, but as it becomes better known it will undoubtedly have a large use. The tantalum lamp does not require any new fixtures, as it fits any socket in which the ordinary incandescent carbon lamp is used.

Although columbite has been found at a number of localities in Mitchell and Yancey counties, there has not been any production of this mineral.

### ZIRCON.

This mineral is mined for its zirconia content, which is used, together with yttria and other rare earth oxides, in the manufacture of the glower for the Nernst lamp. At the present time North Carolina is the only State producing zircon commercially.

### PRODUCTION.

During 1905 the total production of monazite in North Carolina was 894,368 pounds valued at $107,324. This is an increase of 208,369 pounds in quantity and of $27,886 in value as compared with 685,999 pounds valued at 79,438, the production of 1904. The above quantities in each case represent the cleaned sand containing from 85 to 99 per cent monazite. This production was obtained from the following counties: Burke, Cleveland, Lincolnton, McDowell, and Rutherford.

The 1905 production of zircon amounted to 8,000 pounds valued at $1,600, and was obtained from Henderson County. This makes

the total production of these minerals mined for use in the manufacture of various lighting apparatus amount to 902,368 pounds in quantity and valued at $108,924. There is given in the table below the production and value of monazite and zircon mined in North Carolina from 1893 to 1905 inclusive:

PRODUCTION OF MONAZITE AND ZIRCON IN NORTH CAROLINA FROM 1893 TO 1905.

| Year. | Monazite. | | Zircon. | |
|---|---|---|---|---|
| | Pounds. | Value. | Pounds. | Value. |
| 1893 | 130,000 | $ 7,600 | | |
| 1894 | 546,855 | 36,193 | | |
| 1895 | 1,573,000 | 137,150 | | |
| 1896 | 30,000 | 1,500 | | |
| 1897 | 44,000 | 1,980 | | |
| 1898 | 250,776 | 13,542 | | |
| 1899 | 350,000 | 20,000 | | |
| 1900 | 908,000 | 48,805 | | |
| 1901 | 748,736 | 59,262 | | |
| 1902 | 802,000 | 64,160 | 2,000 | $ 380 |
| 1903 | 773,000 | 58,694 | 3,000 | 570 |
| 1904 | 685,999 | 79,438 | 1,000 | 200 |
| 1905 | 894,368 | 107,324 | 8,000 | 1,600 |

## TALC AND SOAPSTONE.

The mining of talc in North Carolina represents one of the more important mining industries in the State and one grade of talc which is obtained from the Hewitt mine in Swain County is as fine a quality of talc as is produced anywhere. The demand for this particular talc is far beyond the supply and inquiries are constantly being received asking for information regarding new sources of supply similar in quality to the Hewitt talc. This talc is used in the manufacture of tailor's pencils, boiler-maker's pencils, gas tips, etc. Talc suitable for grinding into powder for use in the manufacture of talcum powders, soaps, etc., occurs quite extensively in both Swain and Cherokee counties. Pyrophyllite and compact talc or soapstone steatite is mined to a small extent and used, after being ground to a powder, for foundry facings, in the manufacture of paper, etc.

With the exception of a small amount of compact talc or soapstone that is quarried in the mountain counties and used for fire-places, chimneys, etc., there is none of it used for manufactured articles, such as tubs, table-tops, griddles, etc. This is due principally to the lack of railroad facilities. Soapstone deposits that are worthy of

notice and that may prove of value when railroad transportation reaches them are located about 2 miles west of Beaver Creek, Ashe County. At several places quarries have been opened and good material obtained for local use in fire-places, etc. The individual deposits are lens-shaped masses, with a thickness up to several feet long in the enclosing schists, or associated with partially altered peridotite rocks. These lenses show very few fractures or joints, and some are capable of yielding tough, good-sized blocks or slabs. The soapstone saws readily, even though it carries a considerable quantity of only partially altered asbestiform tremolite.

The demand for talc for grinding and also for cutting into pencils, gas tips, etc., is constantly increasing, and at the present time the total production in the United States is not equal to the domestic demand. This scarcity has caused an increase in the price of the better quality of talc and has also caused a considerable quantity of Bavarian soapstone or steatite to be imported. Thus, any new property is worthy of investigation, as many of the larger producers and manufacturers of talc are on the lookout for deposits of talc suitable for their purposes.

### PRODUCTION.

During 1905 the total production of talc and soapstone, with the exception of that mined in the mountain counties and cut into slabs for chimneys, etc., amounted to 4,035 tons valued at $74,690. This is an increase of 234 tons in quantity and of $9,032 in value as compared with 3,801 tons valued at $65,308, the production of 1904. The counties making this production were Swain, Cherokee, and Moore, given in the order of the importance of their productions. There were a total of five producers, the same as for the previous year. Besides the above, there was some soapstone quarried, principally in Ashe County, used for chimneys, fire-places, etc.

Very little of the talc produced is sold in the crude state, and, therefore, the value given for the talc production represents the manufactured products, and the production is classified as it is marketed, as ground, manufactured, rough, and for chimney purposes. In the table below is given the condition in which the 1905 production is marketed, together with that of the years 1903 and 1904:

PRODUCTION OF TALC AND PYROPHYLLITE IN NORTH CAROLINA DURING 1903, 1904, AND 1905.

| CONDITION IN WHICH MARKETED. | 1903. | | 1904. | | 1905. | |
|---|---|---|---|---|---|---|
| | QUANTITY, SHORT TONS. | VALUE. | QUANTITY, SHORT TONS. | VALUE. | QUANTITY, SHORT TONS. | VALUE. |
| Ground talc for powders, etc. | 3,762 | $ 37,606 | 3,163 | $ 32,217 | 3,529 | $ 39,007 |
| Talc cut into pencils, gas tips, etc. | 265 | 27,615 | 208 | 28,673 | 205 | 32,568 |
| Talc sold crude | 1,304 | 11,763 | 430 | 4,417 | 301 | 3,115 |
| Soapstone cut into slabs for chimneys, etc. | | | | 175 | | 250 |
| Total | 5,331 | 76,984 | 3,801 | 65,483 | 4,035 | 74,940 |

The next table shows the quantity and value of talc and soapstone produced in North Carolina from 1898 to 1905 inclusive:

PRODUCTION OF TALC AND SOAPSTONE IN NORTH CAROLINA, 1898 TO 1905 INCLUSIVE.

| YEAR. | QUANTITY. | VALUE. | YEAR. | QUANTITY. | VALUE. |
|---|---|---|---|---|---|
| | *Short Tons.* | | | *Short Tons.* | |
| 1898 | 1,695 | $ 27,320 | 1902 | 5,239 | $ 88,962 |
| 1899 | 1,817 | 31,880 | 1903 | 5,331 | 76,984 |
| 1900 | 4,522 | 75,308 | 1904 | 3,801 | 65,483 |
| 1901 | 5,819 | 77,974 | 1905 | 4,035 | 74,940 |

## PRECIOUS STONES.

The precious stones or gem minerals of North Carolina have been described in some detail in previous reports* and there is now in press a bulletin on the Precious Stones of North Carolina by Dr. George F. Kunz, of Tiffany & Co., New York City.

### PRODUCTION.

The total value of the production of precious stones of all kinds in North Carolina during 1905 was $3,350, which is a decrease of $6,250 as compared with $10,600, the value of the 1904 production. This large decrease is due largely to the fact that the beryl mines at Spruce Pine were only operated a very small portion of the year.

There is given in the following table the production of precious stones in North Carolina since 1900.

* Economic Papers 6 and 9; Vol. I, N. C. Geological Survey.

PRODUCTION OF PRECIOUS STONES IN NORTH CAROLINA SINCE 1900.

| YEAR. | VALUE. |
|---|---|
| 1900 | $12,020 |
| 1901 | 24,245 |
| 1902 | 5,300 |
| 1903 | 1,525 |
| 1904 | 10,600 |
| 1905 | 3,350 |

## MINERAL WATERS.

The production and sale of mineral waters in North Carolina, while it has not yet reached a very large industry, has possibilities of becoming an industry of considerable value to the State. Most of the water that is bottled and sold is used for medicinal purposes, and there is very little that is marketed which could be called a purely table water. Spring water is being used more and more for table use, and North Carolina has springs of large flow whose water is pure, and if once introduced on the market would undoubtedly find wide favor as table water. During 1905 there were 10 springs that reported sales as follows:

Alkalithia Spring, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Jackson Spring, Jackson, Moore County.
Mida Spring, near Charlotte, Mecklenburg County.
Panacea Spring, near Littleton, Halifax County.
Red Spring, Red Springs, Robeson County.
Seven Springs, near Goldsboro, Wayne County.
Thompson Bromine-Arsenic Spring, Crumpler, Ashe County.
Vade Mecum Spring, Stokes County.

Many of these springs have hotels run in conjunction with them, having a total accommodation for about 1,000 people. Besides these springs that have made sales of water, there are a large number of springs located throughout North Carolina that are used in connection with resorts, such as the Haywood White Sulphur Springs, Waynesville, Haywood County; the Blackwood Sulphur Springs near Alexander, Buncombe County; the Hot Springs at Hot Springs, Madison County; the springs at Sapphire, Jackson County, etc.

### PRODUCTION.

The total amount of mineral water bottled and sold in North Carolina during 1905 amounted to 201,000 gallons valued at $38,755. As compared with 145,800 gallons valued at $21,902 sold in 1904, this is an increase of 55,200 gallons in quantity and of $16,853 in value. In the following table there is given the production of mineral waters in North Carolina since 1901:

PRODUCTION OF MINERAL WATERS IN NORTH CAROLINA SINCE 1901.

| YEAR. | AMOUNT, GALLONS. | VALUE. |
|---|---|---|
| 1901 | 375,700 | $42,167 |
| 1902 | 104,400 | 18,795 |
| 1903 | 83,100 | 13,085 |
| 1904 | 145,800 | 21,902 |
| 1905 | 201,000 | 38,755 |

## GRAPHITE.

### PRODUCTION.

The occurrences and uses of graphite have been described in detail in previous reports on the Mining Industry.* The production of this mineral has never amounted to a great deal in this State, and for the most part has been confined to one county. During the past year the production only amounted to 100 tons valued at $475, and was all obtained from Wake County. As compared with the production of the previous year, it is the same in quantity, but a decrease of $50 in value. In the following table there is given the production of graphite from 1901 to 1905 inclusive:

PRODUCTION OF GRAPHITE IN NORTH CAROLINA FROM 1901 TO 1905.

| YEAR. | QUANTITY. | VALUE. |
|---|---|---|
| | *Tons.* | |
| 1901 | 95 | $ 559 |
| 1902 | 830 | 4,300 |
| 1903 | 50 | 248 |
| 1904 | 100 | 525 |
| 1905 | 100 | 475 |

*Economic Papers 6, p. 68; No. 8, p. 48; No. 9, p. 62.

## COAL.

The Chatham and Moore County coal areas are the only producers of coal in North Carolina. These deposits have been thoroughly exploited and it has been shown that the field is not very extensive or capable of being developed into a very large productive region. The seams of coal are faulted in many places, which, together with their narrow width, makes mining expensive. The output of the past few years has been very irregular, and practically all of the production has been made from the Cumnock mines.

### PRODUCTION.

The first record of the production of coal in North Carolina is in the report of the United States Census for 1840, which states a production of 3 tons was obtained. From that time until coal was mined during the Civil War for use by the Confederate Government, there is no record of any coal being produced. From 1862 to 1867 the production was from 20,000 to 30,000 tons a year. It then began to fall off until 1873 the production was reported as 10,000 tons. From that year until 1880 there was no coal produced. For the next ten years the production amounted to only 222 to 500 tons per year. In 1889 the Cumnock or Old Egypt mines were reopened and have been producing ever since, although the production has been very erratic. The year of greatest production was 1899, when the quantity of coal produced was 26,896 tons.

During 1905 the production only amounted to 1,557 tons valued at $2,336, averaging $1.50 per ton. As compared with the production of 7,000 tons valued at $8,820 in 1904, this is a decrease of 5,443 tons in quantity and of $6,484 in value. Over two-thirds of this coal was sold to the local trade or used by employees. In the following table is shown the distribution of the coal product of North Carolina for the years 1901 to 1905.*

* U. S. Geological Survey; mineral resources separate on Coal, 1906.

DISTRIBUTION OF THE COAL PRODUCT OF NORTH CAROLINA, 1901-1905.

| YEAR. | LOADED AT MINES FOR SHIPMENT. | SOLD TO LOCAL TRADE AND USED BY EMPLOYEES. | USED AT MINES FOR STEAM AND HEAT. | TOTAL QUANTITY. | TOTAL VALUE. | AVERAGE PRICE PER TON. | AVERAGE NUMBER OF DAYS ACTIVE. | AVERAGE NUMBER OF EMPLOYEES. |
|---|---|---|---|---|---|---|---|---|
| | *Short Tons.* | *Short Tons.* | *Short Tons.* | *Short Tons.* | | | | |
| 1901 | 10,000 | ---------- | 2,000 | 12,000 | $ 15,000 | $ 1.25 | 300 | 25 |
| 1902 | 20,400 | 100 | 2,500 | 23,000 | 34,500 | 1.50 | 285 | 40 |
| 1903 | 14,429 | 87 | 2,793 | 17,309 | 25,300 | 1.47 | 264 | 49 |
| 1904 | 4,600 | 300 | 2,100 | 7,000 | 10,500 | 1.50 | 240 | 25 |
| 1905 | 461 | 1,096 | ---------- | 1,557 | 2,336 | 1.50 | 60 | 15 |

The next table shows the production of coal in North Carolina since 1890, when the Cumnock mine was reopened.

COAL PRODUCTION IN NORTH CAROLINA FROM 1890 TO 1905.

| YEAR. | QUANTITY. | YEAR. | QUANTITY. |
|---|---|---|---|
| 1890 | 10,262 | 1898 | 11,495 |
| 1891 | 20,355 | 1899 | 26,896 |
| 1892 | 6,679 | 1900 | 17,734 |
| 1893 | 17,000 | 1901 | 12,000 |
| 1894 | 16,900 | 1902 | 23,000 |
| 1895 | 24,900 | 1903 | 17,309 |
| 1896 | 7,813 | 1904 | 7,000 |
| 1897 | 21,280 | 1905 | 1,557 |

## PEAT.

The peat deposits of North Carolina are beginning to attract considerable attention, and during the past year many inquiries have been received regarding them. This is due partly to the many uses for which peat is adapted, the more important one being as a fuel, usually in the form of briquettes. It is found in swamps, marshes and bogs, where the drainage is hindered sufficiently to permit of vegetable growth. This accumulates and slowly decays under water, becoming constantly deeper. As examined, a peat deposit will usually show on top a layer of living vegetable matter; underneath this a mixture of partly decayed plants still showing well-defined fiber; and below this the spongy to black peat in which there may be a total absence of any fiber.

Swamps and marshes in which peat occurs may be either fresh-water swamps or marine swamps and marshes, and both these types are abundant in what is known as the "swamp lands" of eastern North Carolina, in many of which there are vast deposits of peat of varying quality and purity. There are also bogs and swamps in the Piedmont plateau and mountain regions of the State that may contain deposits of peat that are worthy of investigation.

In appearance, peat is often fibrous, although in many samples but few fibers can be distinguished. It is brownish to black in color, the latter representing the more thoroughly decomposed variety, which is more or less spongy and waxy and contains few or no fibers, while the brownish color is of the less decomposed peats, which are loose in texture and decidedly fibrous. When the peat is first taken out of these swamps it contains a very large percentage of water, the greater portion of which is readily lost by evaporation, but it requires a rather high temperature to eliminate all the water. Besides the decayed vegetable matter, peat contains more or less mineral matter which constitutes the ash. This often consists largely of clay, iron oxide, and calcium carbonate, and varies in peat, which will make a good fuel from 3 to 10 per cent.

The uses of peat are quite varied, the chief one being as a fuel. For this purpose it may be used directly after being dried, or after being manufactured into briquettes, the latter giving better satisfaction and greater heating efficiency. It can also be used in the manufacture of coke with by-products, such as gas, ammonia, tar, etc. It could also be used in the production of gas. For these uses, especially as a fuel in the form of briquettes, the deposits of eastern North Carolina are worthy of most serious consideration and thorough investigation.

The fibrous and spongy nature of the peat makes it of value for use as an absorbent in the manufacture of paper and for litter.

For agricultural purposes peat can be used to advantage, for its nitrogen content, and for this purpose the deposits of eastern North Carolina offer a promising field for investigation. It can also be used in packing as a non-conductor of heat and sound, and as a preservative for packing perishable articles, such as fish and fruits, for transportation.

During the coming year it is planned to thoroughly investigate the peat deposits of the State and to prepare for publication a report upon their occurrence, extent, chemical composition, value, etc.

The State Geologist would appreciate it if any one owning land containing peat will notify him of the extent of the bog or swamp and also send sample of the peat.

## STONE.

### INTRODUCTION.

There has recently been published by the North Carolina Geological and Economic Survey a report on the Building and Ornamental Stones of the State, which was prepared by Prof. Thomas L. Watson and Mr. Francis B. Laney, with the collaboration of Dr. George P. Merrill. This report represents nearly three years of field and laboratory work, and shows that North Carolina is well supplied with a great variety of building stone materials, particularly those of a granitic type. With perhaps the possible exception of Georgia, it is better supplied both as regards quality and variety than any of the other Appalachian States south of New England. When this fact is taken in connection with the mildness of the climate, which permits of a long season of outdoor labor, and with the cheapness of labor itself, it will undoubtedly result in the development of a very extensive industry.

The granitic rocks have been especially studied by Mr. Watson, who worked almost exclusively on the granites and gneisses, with incidental reference to the associated eruptives, the diorites, diabases and gabbros. In connection with the field work on these granitic rocks, he was ably assisted by Mr. Laney, who, however, devoted the larger part of his time to the marbles, limestones, sandstones, serpentines and road materials.

Dr. Merrill's guiding hand is plainly seen in the character of the work and its form of presentation. There were but few tests made to ascertain resistance to crushing, shearing, elasticity, or absorption, chiefly because the report does not pretend to be either exhaustive or final, but has been published to call attention to the deposits of stone, especially those of known economic importance, and to indicate how these can be opened and operated profitably. No chemical analyses were attempted, nor were they for the most part considered essential

for the present work, as Dr. Merrill still adheres to his opinion that more can be learned from an examination in the field than through all known laboratory tests taken together. There are a number of chemical analyses given throughout the report, which have been taken, however, from previous reports of the Survey.

The volume is divided into nine chapters, with a short appendix on Stones for Road Building. In Chapter I, which is entitled Preliminary Generalities, the essential qualities of building stones are thoroughly discussed, attention being called to the influence that color has on the market value of a stone; the ease or difficulty with which a stone can be worked, and the location of the deposit with respect to transportation facilities. The surface features of the State are considered, and it is shown that the geological formations which are capable of yielding desirable stone for structural purposes or ornamentation traverse the State in northeast and southwest directions. Beginning at the western margin of the coastal plain, there is found extending northeast from Raleigh a broad belt of gneissic rocks, succeeded on the west by one of brown sandstone, and this in order by belts of schist, granites and gneisses to the State line, the last-mentioned belt carrying in Cherokee, Graham, and Swain counties a narrow belt of marble. Within these areas there are numerous minor exceptions to the regular order mentioned above. The geographic position of the State is considered with reference to other than local markets, and it is clearly shown that North Carolina is near the center of an area containing hundreds of large and prosperous cities and towns which will afford a market for a much larger amount of building stones than it is now supplying, which should result in the development of the quarry industry on a much larger scale and without any danger whatever of ruinous competition.

Chapters II, IV, and VI take up in detail the building and decorative stones roughly classified as follows: (1) The crystalline siliceous rocks, including the granites, gneisses and diabases, or trap-rocks; (2) the calcareous rocks, including all limestones and dolomites, both the crystalline and compact common varieties; and (3) the fragmental or clastic rocks, including the sandstone and clay slates.

The granites and other crystalline rocks result either as erupted molten matter from the earth's interior or from the metamorphism of siliceous sediments. Those of the second group originate mainly as

deposits of calcareous mud from the breaking up of shells, corals, and the remains of other marine animals on an old sea bottom. Those of the third group result from the breaking up of older rocks, and the accumulation on the bottom of lakes and seas of the resultant sand, clay, or mud in beds of varying thickness, to be subsequently hardened into stone.

"The essential difference between a marble and a compact limestone, like those of Ohio or Kansas, is that the first has undergone, through the combined action of heat and pressure, just the right degree of change, or metamorphism as it is technically called, to develop in it crystallization and color; the essential difference between a brick or fire-clay and a cleavable slate suitable for roofing is, as explained elsewhere, that the first named still retains its plastic condition as it was laid down in the form of fine silt on a sea bottom, while the slate has by geological agencies, by actual movements of the earth's crust, been so squeezed and compressed as to lose all resemblance to its former self, and become the cleavable article of commerce we now find it.

"These processes of change, as noted above, are dependent very largely upon the actual movements, warpings and foldings, as one might say, of the earth's crust and the heat and chemical action which is thereby generated, and since these movements take place only with extreme slowness, whole geologic ages being occupied in their inception and completion, it follows as a matter of course that these metamorphic rocks, these gneisses, marbles and roofing slates, are found only among the older rocks and only in those portions of the country where this crust has been warped, compressed, and folded as in the process of mountain making."

Thus, one will find these rocks in their best development in those regions bordering along more or less extensive mountain ranges.

### GRANITE AND OTHER CRYSTALLINE ROCKS.

The area of the State containing rocks of the first class is very extensive, and includes the three larger physiographic provinces of the State, namely, the Coastal Plain, the Piedmont Plateau, and the Appalachian Mountain; but the greater part of the granites and other crystalline rocks of economic importance are included in the Piedmont Plateau region. Along the inner margin of the coastal

plain region there are a number of small workable areas of granite of excellent quality; but in the mountain region the large granitic areas are usually schistose in structure and are not very desirable for the higher grades of work in which granites are used. These crystalline rocks are discussed in groups:

I. The Coastal Plain Region. This area includes Wilson, Edgecombe, Nash, Anson, and Richmond counties. In this region the areas capable of producing workable granite either lie close to or are crossed by the principal lines of railroad in the eastern part of North Carolina, rendering them easily accessible and providing ample facilities for transportation of the stone. The outcrops are usually large and are so located as to offer advantageous quarry sites. They are all biotite granites, showing a considerable range of variation in color and texture, from light gray to pink, with occasionally a mixed yellowish and pink appearance. No systematic quarrying has as yet been undertaken, and all that has been quarried has been used locally.

II. The Piedmont Plateau Region. 1. The Northeastern Carolina Granite Belt, including Wake, Franklin, Vance, Granville, and Warren counties. In this belt extensive workable areas of different grades of granite are found suited for all classes of work in which granite is used, except for the better grades of monumental work. Systematic quarrying, however, has been limited, principally to areas in and around Raleigh, Wake County, and at and near Greystone and Middleburgh, Vance County. These quarries have been operated quite extensively, furnishing stone to eastern Virginia and Carolina, principally in the form of blocks and curbing for street purposes; and for general building purposes. Throughout this belt the granites show but little variation in mineral composition, and, with one exception, they are biotite-granites. Minerals, such as free sulphides and iron oxides, which are a source of discoloration to stone on exposure, are practically absent from the granites of this belt.

2. The Carolina Metamorphic Slate and Volcanic Belt, including Orange, Durham, and Chatham counties: The country rocks of this belt comprise argillaceous, sericitic and chloritic metamorphosed slates and crystalline schists; sedimentary pre-Juratrias slates and ancient volcanic rhyolites, quartz-porphyries, and pyro-clastic breccias that are often sheared and altered andesites. Rocks of granitic composition have as yet only been noted in Orange County, and they

are of doubtful commercial value except for railroad ballast and road purposes.

3. The Carolina Igneous Belt (The Main Granite Belt), including Mecklenburg, Gaston, Cabarrus, Iredell, Rowan, Davidson, Davie, Forsyth, Guilford, and Alamance counties. In this belt granite is one of the principal and most wide-spread rocks, and in each of the ten counties included in the belt extensive areas of granite are exposed. Outcrops of firm and hard moderately fresh granites are not uncommon, and, as a rule, the exposures are large enough to admit of the opening of large quarries without much stripping. The stone is usually well suited to the many purposes for which granite is used, and the belt is traversed in nearly all directions by lines of railroads which offer ample facilities for transportation. Notwithstanding these conditions, only a limited amount of quarrying has been done in these counties, with the exception of Rowan, where a systematic quarrying has been developed in a large scale on the Dunns Mountain granite ridge.

There are two distinct phases of the granite developed, an even-granular or normal and a porphyritic granite, both of which have wide distribution within the limits of the belt, and, with one exception, represent different phases of the same rock mass, the porphyritic texture grading into the even-granular. With hardly an exception the granites are mica (biotite) bearing, and they vary in color from nearly white, through the lighter to the darker shades of gray. In several places over Dunns Mountain a beautiful shade of pink granite is quarried. This stone has attracted a great deal of attention, and is much admired as a decorative stone.

4. The Western Piedmont and Granite Belt, including Surry, Wilkes, Alleghany, Alexander, and Cleveland counties. In this belt the massive granites are less abundantly distributed than over other parts of the granitic areas. They are all biotite-bearing, usually of light color and of medium texture. No injurious minerals are, as a rule, observed, the rocks possessing marked strength and durability, and are very desirable granites for certain grades of work. Mount Airy, Surry County, one of the principal localities in this belt yielding rock of this type, constitutes the largest quarrying center in the State. The demand for this stone is rapidly increasing, and wherever used has given entire satisfaction both as regards color and durability.

III. The Appalachian Mountain Region, comprising McDowell, Buncombe, Henderson, Madison, Haywood, Jackson, Macon, Transylvania, Swain, Mitchell, Caldwell, Watauga, and Ashe counties.

No systematic quarrying has as yet been undertaken at any point in this mountain region, but numerous small openings have been made in exposures of the rock in many places, the stone being used entirely for local purposes. The larger amount of the rock quarried has been used for ballast and road purposes. Transportation is the serious difficulty confronting the quarrying of the mountain granite for building purposes, except for local use.

The report shows that North Carolina is well supplied with granite deposits that are easily accessible and are of a quality that will permit of their being used for all grades of work.

Some of the rocks included under the head of the crystalline rocks are of especial interest and are mentioned more in detail.

*Orbicular Gabbro-Diorite.*—The orbicular gabbro-diorite is found on the Hairston plantation, Davie County, 10 miles west of Lexington and one mile west of Oaks Ferry. It occurs in high boulders, occupying a low indistinct ridge, which culminates in a peak or knoll about 30 feet above the surrounding plain. This is the only point where the orbicular rock outcrops prominently, but it can be traced in a southwest direction by means of residual decay for a distance of one-half to three-quarters of a mile in length and of several hundred yards in width. The orbicular rock undoubtedly occurs in the form of a typical dike, penetrating the porphyritic granite, and is parallel to and probably of the same age as some large massive unaltered diabase dikes in the vicinity which are intersecting the same rock.

This rock presents two distinct and strongly contrasted phases, one the pronounced orbicular and the other a granitic. Around the knoll referred to, the rocks show the typical orbicular texture, with the well-rounded spheres varying in width from one-eighth to one inch and sometimes two inches in diameter. Some distance from the knoll the rock assumes a granitic texture, but is composed of the same minerals. Mineralogically, this rock is composed principally of a basic plagioclase feldspar, showing, as a rule, but slight polysynthetic twinning, uralitic hornblende, and diallage. Besides these, titanite, apatite, magnetite and zircon occur as accessory minerals, and quartz, muscovite, calcite and zoisite as secondary minerals.

In color the rock is dark, with a greenish tinge due to the dark green hornblende. It has a pronounced mottled appearance produced by the nearly black green nodules of hornblende in a groundmass of the intensely white plagioclase feldspar. The contrast is very pleasing, and it is brought out much more prominently in the cut and polished surface. The spheres usually exhibit a fibrous radiating structure from a common center outward. In some instances a small fragment of feldspar, quartz, or pyrite has been the nucleus about which the spheres of the hornblende have been formed. The concentric structure which is usually observed in orbicular rocks is not at all pronounced in the North Carolina rock; and where the spheres of orbicular granite and diorite heretofore described are composed usually of a number of minerals, the North Carolina rock is only composed of one, the dark-green hornblende.

As a decorative or ornamental stone, this unique stone should find very great favor. It works easily and well, as is shown by a polished column and sphere that are in the State Museum at Raleigh. That it wears well is demonstrated by the fact that some of this stone quarried prior to the Civil War and used for gate-posts and steps to the house on the Peter Hairston property do not show any signs of decay. This deposit is being developed by the Consolidated Granite Company of Winston-Salem, and already many inquiries have been received regarding it.

*Quartz-Porphyry (Leopardite).*—Intersecting the biotite-granite at Belmont Springs, 1½ to 1¾ miles east of Charlotte, Mecklenburg County, is a dike of quartz-porphyry about one-half mile long, whose width nowhere exceeds 25 feet and which has been most appropriately named leopardite. It is a dense, hard, tough and compact cryptocrystalline rock, which breaks with a conchoidal fracture. The fresh rock is nearly pure white, tinged in places a very faint greenish, and penetrated by long parallel streaks or pencils of a dead black color. If it is broken at right angles to these streaks the surface is dotted with rounded irregular black spots, varying from pin-heads up to half an inch in diameter. When the rock is broken or cut parallel with the direction of the pencils the surface is streaked with long irregular black lines, which are sometimes approximately parallel and at others assume a dendritic or fern-like appearance. These black streaks or pencils are not regularly distributed throughout the quartz-

porphyry, but in some areas they are entirely absent, while in others they are crowded very closely together.

Mineralogically, the rock is composed essentially of feldspar, both potash and plagioclase varieties, with a smaller amount of quartz, which forms minute irregular interlocking grains. Considerable of it is interwoven with the feldspar in micrographic structure, forming more or less rounded disk-like areas. The black streaks or pencils are composed of oxides of manganese and iron and are supposed to represent the percolation of manganese and iron solutions through the rock.

The rock is susceptible of an excellent polish and could be used with splendid effect in inlaid work. On account, however, of its exceeding hardness and toughness and absence of any definite rift, it will be a rather expensive stone to quarry. This rock is also being developed by the Consolidated Granite Company of Winston-Salem.

*Unakite.*—In Madison County, about 5 miles southwest of Hot Springs, there is an irregular area of granite containing epidote as a characterizing mineral. The main mass of this rock is described as a dark pink and green epidote-biotite-granite of coarse texture and somewhat schistose structure varying from a typical schistose granite in which the quartz is present in the usual amount to a nearly quartzless rock of the same color and texture.

Penetrating this granite probably in the form of narrow veins is the unique and beautiful variety of granite known as unakite. This rock is composed of yellow-green epidote, dull pink or red feldspar and quartz. The unakite is not uniform in color and composition, but shows pronounced gradations into a highly feldspathic rock of pink color on the one hand and an epidote rock of a yellow-green color on the other. Usually in the veins the normal unakite, which is a coarse, massive rock of even texture, occupies the middle portion of the vein and graduates toward the enclosing gneiss either into the feldspathic or epidotic rock or both.

Under the microscope the unakite is shown to be composed of the usual granitic minerals, such as orthoclase, quartz, occasional biotite, zircon, apatite, rutile, magnetite and a few small grains of pyrite, with the secondary minerals epidote, chlorite, kaolin and a green mica.

One of the best exposures of the unakite in its relation to the other granitic rock is along Roaring Fork and a short distance above its

acres in extent may be raised in this manner, affording a bed plane approximately horizontal, to which the quarrymen can work, thus securing stone of any required thickness. The first time compressed air was used a pressure of 80 pounds was admitted into the cavity which had previously been extended to a distance of 100 feet from the lift-hole. The power of the air, however, was too great for the easily-splitting stone and the cleavage turned abruptly to the surface. In the next hole, however, the compressed air was admitted very gradually and the stone could soon be heard cracking in all directions, and in about half an hour the cleavage came to the surface of the hillside as a thin edge some 225 feet from the lift-hole. To extend the cleavage by means of powder for a hundred feet would require from 6 to 12 days, and with water from 3 to 5 hours, while with the compressed air the larger area was split in half an hour."

Appended to the volume is a short description of stone found throughout the State that is suitable for road building, together with a table showing the results of tests made on certain stones suitable for use in road building.

Although this volume deals especially with the economic and commercial phases of the building stones of North Carolina, making it particularly interesting and valuable to contractors, builders and dealers in building stones; yet there is sufficient detailed scientific work included to make it of considerable interest and value to the student of North Carolina geology.

## PRODUCTION OF BUILDING STONES.

In 1905 the total value of the production of all kinds of stone in North Carolina was $597,922. As compared with $312,576, the value of the 1904 production, this is an increase of $285,346.

There is given in the table below the value of the production of the various stones quarried in 1900 to 1905:

PRODUCTION OF BUILDING STONES IN NORTH CAROLINA, 1900-1905.

| YEAR. | GRANITE. | SANDSTONE. | MARBLE AND LIMESTONE. | TOTAL VALUE. |
|---|---|---|---|---|
| | *Value.* | *Value.* | *Value.* | |
| 1900 | $ 257,962 | $ 27,210 | $ * | $ 285,172 |
| 1901 | 264,906 | 11,682 | 8,357 | 284,945 |
| 1902 | 338,749 | 4,825 | 23,153 | 366,727 |
| 1903 | 334,357 | 600 | 25,365 | 360,322 |
| 1904 | 292,439 | 250 | 19,887 | 312,576 |
| 1905 | 564,425 | 4,482 | 29,015 | 597,922 |

* Statistics not collected for 1900.

## PRODUCTION OF GRANITE.

There was a most gratifying increase in the production of granite during 1905 as compared with that of any previous year. This is due to the more extensive advertising of North Carolina granite and its favorable reception in new markets. During 1905 the total value of all the granite produced was $564,425, which, compared with the value, $292,439, was an increase of $271,986. Although this increase is nearly double that of the previous year, it still does not begin to represent what the granite industry of the State should attain. Next year will undoubtedly see a still further increase in the value of the granite production. The number of operators quarrying the granite during 1905 was 23, an increase of 7 over the number of 1904, and these worked 27 different quarries in the following 12 counties, given in the order of the importance of their productions: Surry, Rowan, Polk, Warren, McDowell, Buncombe, Orange, Henderson, Vance, Davie, Gaston, and Cabarrus. Rockingham, which produced a considerable amount of granite in 1904, used entirely for railroad ballast, did not make a production in 1905. Three new counties, however, are added to the list of those producing granite, namely, Warren, Davie, and Cabarrus. The production from Cabarrus was entirely for railroad ballast and was represented by the same company that was working in Rockingham during 1904, producing ballast for the Southern Railway. The new operator in Warren County is the Wise Granite Company of Wise, who produced granite that was used for a great variety of purposes, including rough and dressed building and monumental stone, paving blocks and curbing and road macadam. Considering the character and extent of the granite deposits of Warren County, this will probably be but the beginning of a granite production in this county which will increase from year to year.

One-half of the granite produced in the State during 1905 was used for building and monumental purposes, the value being $312,362. This is greater than the value of the total production of granite in 1904, and is the best evidence of the great increase in the granite industry, and indicates that a better quality of granite is being quarried and more care and attention is given to methods of quarrying. It is the strongest evidence of the real value of the granite industry to the State and what can be accomplished by push and energy. This

value is over 4 times the value of the granite used for the same purposes in 1904, and is approximately twice as great as the largest value previously reported for granite used for this purpose, which was the production of 1903, when the value was $167,639. There was a slight increase in the value of the granite used for road-making, railroad ballast, etc., the value of the 1905 production being $118,470 as compared with $93,296, the value of the 1904 production. There is given in the following table the value and uses of the granite quarried from 1902 to 1905 inclusive:

USES OF GRANITE PRODUCED IN NORTH CAROLINA IN 1901-1905.

| Uses. | 1901. | 1902. | 1903. | 1904. | 1905. |
|---|---|---|---|---|---|
| Building and monumental purposes | $ 108,574 | $ 167,639 | $ 127,486 | $ 75,632 | $ 312,362 |
| Paving blocks | 10,662 | 6,986 | 30,780 | 15,807 | 48,234 |
| Curbing and flagging | 56,245 | 82,615 | 68,099 | 101,632 | 74,307 |
| Crushed stone for road-making, railroad ballast, etc. | 89,425 | 77,759 | 102,524 | 93,296 | 118,470 |
| Other purposes | | 3,750 | 5,468 | 6,072 | 11,052 |
| Total value | 264,906 | 338,749 | 334,357 | 292,439 | 564,425 |

There is given in the following table the value of the granite product from 1897 to 1905 inclusive, which shows most strikingly the growth of this industry in the State. In nine years it has increased nearly tenfold:

PRODUCTION OF GRANITE IN NORTH CAROLINA, 1897 TO 1905.

| Year. | Value. |
|---|---|
| 1897 | $ 59,236 |
| 1898 | 79,969 |
| 1899 | 225,544 |
| 1900 | 257,962 |
| 1901 | 264,906 |
| 1902 | 338,749 |
| 1903 | 334,357 |
| 1904 | 292,439 |
| 1905 | 564,425 |

## PRODUCTION OF SANDSTONE.

The sandstone industry has not yet assumed any large proportion and for the two years previous has been nearly at a standstill. The sandstone deposits are rather extensive, as described in the report

referred to above, and some of them are capable of being developed into quarries that would furnish a good building stone. There was only one quarry worked in 1905, the Carrington-Gonella quarry, near Sanford, Moore County. A deposit that is rather favorably located for quarrying and gives indications of producing a sandstone suitable for building purposes is on the property of Mr. Benehan Cameron of Raleigh, which is located at Farintosh, Durham County. If a quarry were developed at this locality it would have good railroad transportation.

During 1905 the production of sandstone amounted in value to $4,482. The previous year it was only valued at $250 and in 1903 $600. One encouraging feature of the 1905 production is that nearly all of it was dressed stone for building purposes. In the table below is given the value of the production of sandstone for the years 1897 to 1905 inclusive, and will illustrate how small this industry is in the State:

PRODUCTION OF SANDSTONE IN NORTH CAROLINA, 1897 TO 1905.

| YEAR. | VALUE. |
|---|---|
| 1897 | $11,500 |
| 1898 | 9,100 |
| 1899 | 10,300 |
| 1900 | 27,210 |
| 1901 | 11,682 |
| 1902 | 4,825 |
| 1903 | 600 |
| 1904 | 250 |
| 1905 | 4,482 |

PRODUCTION OF MARBLE AND OTHER FORMS OF LIMESTONE.

Notwithstanding the demand that there is in North Carolina for lime, there is still but a very small amount produced in this State, and nearly all is imported. One of the main reasons for this is the excessive railroad rates on lime shipped from North Carolina kilns. The Blue Ridge Lime Company, who were operating kilns near Fletcher during the past year, have doubled the capacity of their kilns and should very largely increase their production of lime for the coming year. During 1905 the total amount of lime produced amounted to 22,800 bushels valued at $7,660 and was obtained from

Henderson and Buncombe counties. The balance of the production of lime rock in the State for 1905 was used for road macadam and amounted to 17,084 tons valued at $21,355, and was all obtained from New Hanover County. There was no marble at all produced in the State during 1905. The total production of lime rock was valued at $29,015, and is the greatest value reported for any year since the records have been collected.

In the following table is given the value of the production of limestone and marble from 1901 to 1905 inclusive:

PRODUCTION OF MARBLE AND OTHER FORMS OF LIMESTONE, 1901-1905.

| Year. | Value. |
|---|---|
| 1901 | $ 8,357 |
| 1902 | 23,153 |
| 1903 | 25,365 |
| 1904 | 19,887 |
| 1905 | 29,015 |

## SLATE.

There was no production of slate in North Carolina during 1905.

## SAND AND GRAVEL.

There is an enormous quantity of sand and gravel produced each year and utilized for various purposes. The value of a considerable proportion of this sand and gravel amounts to only the time and labor required to dig and haul the material to the point of consumption, and it is practically impossible to estimate or give any quantity or value for a great deal of these materials that are utilized each year. Thus, large quantities that are used in railway, highway, and sidewalk construction have not been estimated. While most of this has a value of from 5 to 15 cents per ton, it has been impossible thus far to obtain any adequate idea of the quantity of the product utilized each year. The general uses of sand outside of those already enumerated are for flux in copper smelting; for fire-proofing; molding sand, which varies considerable in value, as in making fine castings and heavy castings it is necessary to use a particular quality of sand, while for ordinary castings a more ordinary sand can be used; glass-

sand used in the manufacture of glass, which must be a purer sand than that used for any other purpose; building sand used for mortar, plaster and concrete structure; fire-engine and furnace sands, which are particular qualities of sand adapted for these particular purposes; a grinding-sand, which is used for cutting and grinding stone, glass, etc.; sand used in the manufacture of brick, pottery, sanitary ware, etc.; and sand used in sand-blast machines. Gravel is used in large quantities as rough material for ballast on railways and highways and in concrete work. Of the above uses of sand and gravel, statistics have only been collected during the past year for that used in molding. As far as is known, there is no sand produced in North Carolina for use in the manufacture of glass; but for all the other purposes enumerated above there is more or less sand produced in North Carolina.

When it is considered that there are approximately 150,000,000 brick made and used in North Carolina each year besides those imported into the State, which run up well into the millions, one can obtain some idea of the amount of sand that has been used in making the mortar for laying this number of brick. Estimating this amount of sand at one ton per thousand brick and the number of brick used in North Carolina at 200,000,000, it would make 200,000 tons of sand. Besides this large amount of sand there is an enormous quantity used in the manufacture of plaster used in the large number of buildings that have been constructed during the past year.

The figures obtained for the production of molding sand were 859 tons valued at $547. This does not represent all of the sand used for this purpose, as a considerable amount has been used by foundrymen, which has been obtained close by their shops and no special record kept of the quantity or of its cost.

## SAND-LIME BRICK.

The manufacture of sand-lime brick is becoming an industry of some importance in North Carolina, and it offers possibilities of a much greater growth. While as yet the production of these brick in the State is not very large, yet it has increased during the past three years and the brick command a considerably higher price than the clay-brick. As this industry is comparatively new in North Carolina and as it offers possibilities for profitable investment at a

number of localities throughout the State, a short description of sand-lime brick, their manufacture, etc., may be of interest.

A sand-lime brick consists of sand particles that are cemented together by calcium silicate, or calcium magnesium silicate or calcium hydro-silicate. This cementing material is obtained by the action of steam under pressure upon either a high calcium lime or a magnesium lime which has been previously hydrated. The sand and lime in certain definite proportions are mixed together and then sufficient water added to hydrate the lime, when they are molded and put in a furnace and subjected to steam under pressure. There is a definite chemical reaction that takes place, and the calcium silicate or calcium magnesium silicate or calcium hydro-silicate that is formed is a definite chemical compound and forms a strong binding material between the particles or grains of quartz.

As stated by Mr. S. P. Peppel:*

"The sand-lime brick of to-day is the natural outcome of the improvements made in the old mortar brick, which has been known for years. This mortar brick was at first never more than a molded mixture of lime and sand mortar which was allowed to harden in the air. Later, carbon dioxide was supplied artificially in large quantities so as to hasten the process of hardening. The next improvement was the introduction of carbon dioxide under pressure. Following this use of carbon dioxide under pressure and in the presence of moisture, mild heat was applied. This last process is still used to some extent. But the most marked advance was the one which applied an entirely new principle to the hardening of sand and lime mixtures, and produced what is known to-day as sand-lime brick, an entirely different body from that of the mortar brick. This was the invention of Doctor Michaelis. Some twenty-five or thirty years ago he patented a process for the hardening of mixtures of lime and sand by steam under pressure, thereby introducing into the sand-lime brick an entirely different bond from that in the mortar brick, which in reality has no bond, but only a hardened or solidified filler.

"Doctor Michaelis allowed this patent to lapse without commercial development, and in consequence the fundamental principle on which the manufacture of sand-lime brick is based is now public property, and all patents must be on details of manufacture or combinations of such details. The term "mortar brick" should be confined to the brick which is hardened by the solidification of the lime through the formation of carbonates, and should not be confounded with the sand-lime brick, which is a different product and has materially different properties."

There are a number of processes that have been introduced for the manufacture of sand-lime brick, some of which have been patented. They all, however, involve the same fundamental principle, the forma-

* U. S. Geological Survey Mineral Resources, 1903, p. 866.

tion of a calcium silicate bond, and the value of each depends on the economy with which they can be operated.

The following description of the manufacture of sand-lime brick and materials used is drawn largely from the article referred to above. The raw materials used in the manufacture of these brick consist of a comparatively pure quartz sand or granular silicate and a comparatively pure calcium lime or magnesium lime, the former giving the better results. While most any sand could be adapted and would give a hard brick at the time of its manufacture, yet if the sand contains a good many impurities, the brick will yield more readily to weathering than one made with the pure sand. There are a number of localities in Cherokee, Swain, Transylvania, Henderson, Buncombe, Madison, Mitchell, McDowell, Catawba, Lincoln, Gaston, Craven, Beaufort, Onslow, Duplin, Pender, Brunswick and New Hanover counties that contain calcareous rocks, as the limestone, marbles, shell-rock, etc., that are in close proximity to sand-beds, and many of these offer favorable opportunities for the manufacture of sand-lime brick.

It is very essential in the manufacture of these brick that the raw material be properly prepared, for if the lime is not evenly distributed throughout the mixture the strength of the brick will be lessened, and if the material is not thoroughly mixed and the lime thoroughly slaked masses of lime may remain sufficient to cause rupture by expansion during the process of hardening, due to the complete hydration of the unslaked lime by the steam.

It is also necessary to select the raw materials, sand and lime, carefully, if the best results are to be obtained. Sand varies widely in its texture and also in the amount of other minerals constituting impurities that are associated with it. Sand may be very coarse or very fine and all degrees of coarseness between the two. It may contain as impurities clay, mica and feldspar (three silicates) and limonite, a hydrous ferric oxide. Perhaps the most common and widespread impurity of sand is clay. A sand containing up to 6 or 8 per cent of clay can be used without any serious disadvantage. Any larger percentage of clay than this will necessitate the use of a larger percentage of lime to obtain the same quality of brick, and with too high a percentage of clay, the resultant brick will not be as strong and will be apt to disintegrate when acted upon by age and water. Feldspar up to 10 per cent does not seem to have any seriously inju-

rious effect upon the brick. The limonite, iron oxide, does not apparently affect the strength of the brick, but will determine its color, this oxide reacting to give the brick some shade of red color.

Experiments seem to show that for the rapid and economical production of sand-lime brick a certain proportion of very fine sand should be used, and that the stronger brick are obtained by using a mixture of coarse and fine sand in the proportion of 3 parts of coarse to 2 parts of fine to 2 parts of coarse and 1 part of fine sand. The finer the material that is used the more difficult it will be to mix the materials together so as to get a coating or film over each particle of sand; but, on the other hand, the resultant brick will be more compact and have a neater appearance. A sharp sand will give better results than sand with round corners, although sand-lime brick made of this latter sand will have sufficient strength to answer all requirements, especially if some fine material is introduced prior to manufacture. A coarse sand would represent one from 20 to 80 mesh and fine sand from 150 up.

Most any lime can be used in the manufacture of sand-lime brick, but experiments seem to show that a calcium lime will give a stronger brick than a magnesium lime. It is essential for the best results that the lime should not be badly air-slaked, and in determining what lime to use, consideration must be given to the fact that calcium lime air-slakes much more readily and rapidly than magnesium lime. There is usually used from 5 to 10 per cent of lime, according to the quality and type of the lime as well as its condition and proportion. The calcium lime will slake more rapidly in preparing it for manufacture of the brick than the magnesium lime, and thus requires much less time and care to insure a thoroughly slaked product, which is essential to the best success in the manufacture of sand-lime brick. There are two distinct classes of processes for slaking the lime, one in which lime is slaked to putty with a slight excess of water and then allowed to stand for some time. By this method the best possible product is obtained, and this may be used either in the condition of a putty or after being dried and ground to a flocculent powder. The other method is cheaper and easier of operation and consists of slaking the lime to a dry powder, either by the addition of sufficient water during the agitation of the lime to hydrate as completely as possible and still to leave a dry powder, or by slaking with the aid of steam in an enclosed vessel. Most of the lime is slaked prior to being mixed

with the sand, and probably the simplest and surest way of manufacture is by taking the dry sand and a thoroughly slaked dry calcium hydrate (slaked lime) and mixing them thoroughly in the desired proportions before any water is added.

The mixing process should be carried out very carefully and thoroughly in order that the lime may be distributed throughout the entire mass, and in this process the presence of the fine sand seems to assist it materially. There are a great many mixing machines in use and all those of the intermittent type yield a thorough mixture, provided it is retained sufficiently long in the machine. The amount of water introduced should only be just enough to yield a mass which will just cohere together when squeezed so as to be capable of retaining its shape after passing through the press so as to be transferred to the steam or hardening cylinders.

The machinery needed for a sand-lime plant consists of—

Power and transmission;
Lime-preparing machinery;
Mixing apparatus;
Presses;
Hardening cylinders;
Conveyors;
Tracks and trucks.

The power and transmission machinery does not differ materially from that used in other industries.

The lime-preparing machinery has already been incidentally mentioned. When the quicklime processes are used the only preparing machinery necessary is such as will reduce the lump-lime to fine powder. This usually consists of a small crusher and a grinder or pulverizer. This machinery should be so constructed or so located as to confine the dust either to the machine itself or to a small compartment. For plants with sufficient capacity the best arrangement is to have a pulverizer with an air separator.

In plants which hydrate their lime prior to mixing with the sand, the machinery used is some sort of a crusher or breaker, which breaks the lime down to small lumps, varying in size from that of a pea to about ¾-inch in diameter. This breaker is not always used.

Dry hydrate slaking may be divided into two processes, open slaking and inclosed slaking. Open slaking is accomplished in several ways. In the most simple form of open slaking, floor space or bins,

usually constructed of concrete, are used, and sufficient water is added to the lump-lime, so that after it has stood a few days and dried off, it is for the most part slaked. The resultant product is then screened, and the fine material used, and the remainder thrown back for re-slaking. There is a patent process of the same type in which the lime is wet, and then covered with a coating of previously hydrated lime which serves as a protection from the action of the air and retains a good deal of the heat and steam generated. Open slaking machinery properly consists of mixing machinery, which is not covered. There are a number of machines now used for this purpose, some of them on the pug-mill order, and others on the wet or dry plan. Some are patented and some are not. The patents mainly apply to details of manipulation and not to the mixing machines themselves. One of the patents in this class slakes finely-ground quicklime by constant agitation with water, another slakes lime or ground lime to a putty, and then dries this product by the addition of more quicklime.

"The inclosed slaking machines are of three kinds. One kind agitates the lime in an inclosed vessel with water alone; another type not only uses water, but introduces some live or exhaust steam as well; the third kind slakes in an inclosed cylinder, and has been patented; but the patent is at present in the courts, and their decision will decide whether it is public property or not."

The mixing machinery now in use fall pretty closely within the following four types: Wet plan, pug mill, ball or tube mill and an inclosed cylinder with curved paddles or S-shaped mixing arms.

There is at the present time no press that probably gives entire satisfaction and fulfills the following requisites for a good press: Of being able to deliver regularly a pressure of from 200 to 250 tons per brick and yet not break down if by accident the pressure becomes somewhat greater; of filling the mold with great accuracy and uniformity; of having its working parts so arranged that they will be very free from contact with loose sand, which would otherwise cut them out at an alarming rate; of having the linings of its dies and molds made of the hardest material possible. There are two distinct types of presses in use, one known as the ordinary American dry pressed brick machine and other known as the German type of machine, which has a rotary table.

The hardening cylinders consist of enormous steam-tight iron or steel receptacles so constructed that cars loaded with brick can be

readily introduced into them and resembling in appearance enormous boilers or steel tubes with one entire head removable. These vary in size from 5½ to 7 feet in diameter and from 35 to 67 feet in length.

Conveyors, tracks, trucks, etc., vary with different plants and mode of construction of same.

The estimated cost of a well-equipped sand-lime brick plant having a capacity of from 16,000 to 20,000 brick in 10 to 12 hours, independent of the site, is worth from $20,000 to $25,000, varying with the cost of machinery and labor and locality at which it is erected. The cost of production of the brick independent of depreciation of machinery and interest on investment varies from $3 to $5 per thousand, while the selling price ranges in different localities from $8 to $15 per thousand.

### PRODUCTION.

During 1905 the production of sand-lime common brick in North Carolina amounted to 3,185,000 brick valued at $20,953, and 660,000 front brick valued at $8,150, making a total of 3,845,000 brick valued at $29,103. The production of 1904 was 1,800,000 valued at $17,500. The 1905 production was made by three producers, one each in Buncombe, Scotland, and New Hanover counties.

## CLAY.

Although the production of clay products in North Carolina has constantly increased during the past few years, yet the industry does not begin to be as great as the quantity and quality of the various clays in the State would warrant. The better qualities of clays are still shipped outside the State, and there have been no new companies organized to manufacture terra-cotta, pottery or other finer grades of clay products. As has been indicated before, it is not a lack of demand for this product in the State, for large quantities of them are imported each year. The total value of all clay products manufactured in 1905 is largely in excess of that of 1904, amounting to $1,038,430. Including the value of kaolin the total value of the clay industry in the State in 1905 was $1,124,052.

There is a large field for investment in clay products in North Carolina, especially in the manufacture of pressed, fancy and vitrified brick; in the manufacture of earthenware, stoneware and decorative ware; and in the manufacture of porcelain, electrical insulators, etc.

## KAOLIN.

### *Production.*

During 1905 the production of kaolin in North Carolina amounted to 10,988 tons valued at $85,622, as compared with 9,110 tons valued at $76,670 in 1904, being an increase of 1,878 tons in quantity and of $8,952 in value. The average value per ton of the 1905 production was $7.79 per ton, which is a decrease of 62 cents as compared with the average value of $8.41 per ton of the 1904 production. This production was obtained from Jackson, Swain, and Richmond counties, given in the order of the importance of their productions.

## POTTERY CLAY.

### *Production.*

The decline in the pottery industry that was noted in the report for last year continued during 1905, the value of the production being only $13,319 as compared with $13,900, the value of the 1904 production, a decrease of $581. This small production was divided amongst 24 manufacturers in the following 9 counties, given in the order of the importance of their productions: Buncombe, Union, Wilkes, Lincoln, Catawba, Randolph, Chatham, Johnston, and Moore. Montgomery County, which reported a production in 1904, made no production in 1905, but Moore County was added to the list of those producing pottery. None of the 24 manufacturers produced any great amount of pottery, the largest one only producing pottery to the value of $2,000. Of the 1905 production, $387 was the value of red earthenware and $12,932 the value of stoneware.

Notwithstanding the constant demand for red earthenware and stoneware and the large amount of this material that is imported, there has been no special interest aroused in this industry in the State. By utilizing better material for glazing the ware and exercising more care in the manufacture of the pottery a better and more uniform product could be put on the market, but the two essentials for the development of this industry are capital and experienced men.

There was a small amount of pottery clay sold crude in 1905, amounting to 50 tons, valued at $25, and was obtained from Catawba County. The values of the different grades of pottery produced during 1904 and 1905 are given by counties in the following table:

VALUE OF THE POTTERY PRODUCTS OF NORTH CAROLINA BY COUNTIES IN 1904 AND 1905.

| County. | 1904. | | | 1905. | | |
|---|---|---|---|---|---|---|
| | Earthenware. | Stoneware. | Total. | Earthenware. | Stoneware. | Total. |
| Buncombe | $ 31 | $ 1,300 | $ 1,331 | $ 125 | $ 2,725 | $ 2,850 |
| Catawba | | 4,450 | 4,450 | | 1,930 | 1,930 |
| Chatham | | 600 | 600 | | 500 | 500 |
| Johnston | 50 | 350 | 400 | 100 | 150 | 250 |
| Lincoln | 15 | 3,970 | 3,985 | 20 | 2,059 | 2,079 |
| Montgomery | 50 | 300 | 350 | | | |
| Moore | | | | | 100 | 100 |
| Randolph | 150 | 1,040 | 1,190 | | 790 | 790 |
| Union | 100 | 300 | 400 | 100 | 2,400 | 2,500 |
| Wilkes | 42 | 1,152 | 1,194 | 42 | 2,278 | 2,320 |
| Total | 438 | 13,462 | 13,900 | 387 | 12,932 | 13,319 |

## FIRE-CLAY AND PIPE-CLAY.

### *Production.*

Under the head of the production of fire-clay and pipe-clay products are included fire-brick, sewer-pipe, drain tile, fancy tile, flue linings, terra-cotta, etc., and fire-clay and pipe-clay sold crude. In 1905 the total value of all these products reported was $111,272. This is a decrease of $2,928 as compared with $114,200, the value of the production of 1904. This branch of the clay industry in North Carolina has up to the past year increased rapidly since 1900, but there is plenty of room for a much greater advance to be made.

Of the 1905 production, $8,333 was the value of 681,000 fire-brick, which were manufactured in Buncombe and Cabarrus counties. This is an increase of 518,000 brick in quantity and of $5,633 in value as compared with 163,000 brick valued at $2,700, the production of 1904. There was also a small amount of crude fire-clay sold in 1905 amounting to 57 tons valued at $494. The production of terra-cotta, sewer-pipe, tiling, drain tiles, etc., during 1905 was valued at $102,445, and was obtained from Guilford, Wake, Beaufort, Randolph, and Forsyth counties, given in the order of the importance of their productions. This is a decrease of $8,355 in value as compared with $110,800, the value of the 1904 production. There is given in the following table the production of fire-clay and pipe-clay products for the past 5 years and shows the decided increase in the value of this industry:

## NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1905, BY COUNTIES.

| COUNTY. | COMMON BRICK. | VALUE. | PRESSED BRICK. | VALUE. | VITRIFIED AND FIRE BRICK. | VALUE. |
|---|---|---|---|---|---|---|
| Alamance | 4,275,000 | $ 27,950 | | $ | | $ |
| Anson | 250,000 | 1,500 | | | | |
| Beaufort | 2,425,000 | 14,850 | | | | |
| Bertie | 75,000 | 450 | | | | |
| Bladen | 125,000 | 750 | | | | |
| Buncombe | 4,340,000 | 26,833 | 55,000 | 725 | 481,000 | 5,683 |
| Burke | 1,240,000 | 6,250 | | | | |
| Cabarrus | 8,200,000 | 53,200 | 500,000 | 10,000 | 500,000 | 6,250 |
| Caldwell | 3,300,000 | 16,500 | | | | |
| Catawba | 3,200,000 | 14,750 | | | | |
| Chatham | 300,000 | 1,500 | | | | |
| Chowan | 1,100,000 | 7,700 | | | | |
| Cleveland | 825,000 | 4,800 | | | | |
| Columbus | 2,075,000 | 12,500 | | | | |
| Craven | 8,764,000 | 48,765 | | | | |
| Cumberland | 3,000,000 | 16,500 | | | | |
| Davidson | 3,000,000 | 19,000 | | | | |
| Duplin | 40,000 | 263 | | | | |
| Durham | 9,475,000 | 57,063 | | | | |
| Edgecombe | 4,975,000 | 29,950 | 120,000 | 1,200 | | |
| Forsyth | 10,283,000 | 55,915 | | | | |
| Franklin | 2,300,000 | 14,500 | | | | |
| Gaston | 2,220,000 | 11,520 | | | | |
| Greene | 810,000 | 5,420 | | | | |
| Guilford | 8,133,000 | 47,799 | | | | |
| Halifax | 4,850,000 | 26,950 | | | | |
| Harnett | 100,000 | 700 | | | | |
| Haywood | 550,000 | 3,025 | | | | |
| Henderson | 1,000,000 | 5,000 | | | | |
| Iredell | 1,200,000 | 7,200 | | | | |
| Johnston | 3,515,000 | 22,240 | | | | |
| Lenoir | 700,000 | 3,500 | | | | |
| Lincoln | 20,000 | 120 | | | | |
| McDowell | 300,000 | 1,800 | 200,000 | 2,000 | | |
| Madison | 125,000 | 625 | | | | |
| Mecklenburg | 5,000,000 | 27,500 | | | | |
| Moore | 1,809,000 | 9,854 | | | | |
| Nash | 1,500,000 | 9,000 | | | | |
| New Hanover | 2,750,000 | 16,500 | | | | |
| Orange | 550,000 | 2,750 | | | | |
| Pasquotank | 2,400,000 | 13,600 | | | | |
| Pender | 500,000 | 3,000 | | | | |
| Perquimans | 190,000 | 1,330 | | | | |
| Pitt | 1,100,000 | 6,950 | | | | |
| Randolph | 2,396,000 | 13,183 | | | | |
| Robeson | 2,345,000 | 16,888 | | | | |
| Rockingham | 2,450,000 | 14,450 | | | | |
| Rowan | 3,760,000 | 21,800 | | | | |
| Rutherford | 435,000 | 2,556 | | | | |
| Scotland | 300,000 | 1,800 | | | | |
| Stokes | 1,000,000 | 7,000 | | | | |
| Surry | 870,000 | 5,080 | | | | |
| Union | 3,674,000 | 19,900 | | | | |
| Wake | 4,808,000 | 28,559 | | | | |
| Washington | 100,000 | 800 | | | | |
| Wayne | 10,750,000 | 59,563 | | | | |
| Wilkes | 1,500,000 | 9,000 | | | | |
| Wilson | 6,166,000 | 37,000 | | | | |
| Yadkin | 167,000 | 838 | | | | |
| Total | 153,610,000 | 896,289 | 875,000 | 13,925 | 981,000 | 11,933 |

## NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1904, BY COUNTIES.

| COUNTY. | COMMON BRICK. | VALUE. | PRESSED BRICK. | VALUE. | VITRIFIED AND FIRE BRICK. | VALUE. |
|---|---|---|---|---|---|---|
| Alamance | 4,440,000 | $ 25,750 | | $ | | $ |
| Beaufort | 2,840,000 | 17,000 | | | 30,000* | 300 |
| Bertie | 1,475,000 | 8,850 | | | | |
| Bladen | 300,000 | 1,800 | | | | |
| Buncombe | 3,575,000 | 18,860 | 100,000 | 1,250 | 153,000† | 2,600 |
| Burke | 550,000 | 2,800 | | | | |
| Cabarrus | 5,350,000 | 26,750 | 100,000 | 1,000 | | |
| Caldwell | 2,200,000 | 8,800 | | | | |
| Carteret | 341,000 | 1,850 | | | | |
| Catawba | 1,960,000 | 10,045 | | | | |
| Chatham | 151,000 | 708 | | | | |
| Chowan | 1,000,000 | 7,000 | | | | |
| Cleveland | 915,000 | 4,800 | | | | |
| Columbus | 2,000,000 | 10,300 | | | | |
| Craven | 8,639,000 | 47,515 | | | | |
| Cumberland | 1,750,000 | 9,500 | | | | |
| Davidson | 1,075,000 | 5,300 | 5,000 | 75 | | |
| Duplin | 26,000 | 174 | | | | |
| Durham | 3,665,000 | 19,625 | | | | |
| Edgecombe | 6,075,000 | 36,200 | | | | |
| Forsyth | 5,380,000 | 28,540 | | | | |
| Gaston | 3,500,000 | 19,400 | | | | |
| Gates | 90,000 | 270 | | | | |
| Greene | 60,000 | 420 | | | | |
| Guilford | 13,450,000 | 78,368 | 50,000 | 500 | 100,000* | 850 |
| Halifax | 4,100,000 | 24,000 | 125,000 | 1,250 | | |
| Harnett | 250,000 | 1,450 | | | | |
| Haywood | 800,000 | 4,400 | | | | |
| Henderson | 2,000,000 | 10,000 | 30,000 | 300 | 300,000* | 2,700 |
| Iredell | 995,000 | 5,250 | | | | |
| Johnston | 2,840,000 | 15,800 | | | | |
| Lenoir | 500,000 | 2,000 | | | | |
| Lincoln | 1,225,000 | 6,300 | | | | |
| McDowell | 450,000 | 2,700 | 200,000 | 2,000 | | |
| Macon | 150,000 | 750 | | | | |
| Mecklenburg | 3,500,000 | 21,000 | | | | |
| Montgomery | 10,000 | 40 | | | | |
| Moore | 2,900,000 | 16,400 | | | | |
| Nash | 1,300,000 | 7,800 | | | | |
| New Hanover | 2,750,000 | 17,125 | 800,000 | 10,000 | | |
| Orange | 1,217,000 | 6,628 | | | | |
| Pasquotank | 1,900,000 | 10,800 | | | | |
| Pitt | 2,200,000 | 13,200 | | | | |
| Randolph | 990,000 | 5,266 | | | 10,000† | 100 |
| Robeson | 1,805,000 | 10,788 | | | | |
| Rockingham | 7,580,000 | 38,075 | 100,000 | 1,000 | | |
| Rowan | 4,100,000 | 23,000 | | | | |
| Rutherford | 1,000,000 | 5,700 | | | | |
| Scotland | 500,000 | 3,000 | | | | |
| Surry | 1,325,000 | 6,375 | | | | |
| Transylvania | 125,000 | 750 | | | | |
| Union | 4,879,000 | 24,768 | | | | |
| Wake | 5,717,850 | 31,479 | | | | |
| Washington | 300,000 | 2,400 | | | | |
| Wayne | 9,000,000 | 49,625 | | | | |
| Wilkes | 1,500,000 | 7,500 | | | | |
| Wilson | 5,273,000 | 30,500 | | | | |
| Total | 143,988,850 | 795,494 | 1,510,000 | 17,375 | 593,000 | 6,550 |

*Vitrified brick.

† Fire brick.

PRODUCTION OF FIRE-CLAY AND PIPE-CLAY PRODUCTS IN NORTH CAROLINA, 1901-1905.

| YEAR. | FIRE-BRICK. | | SEWER-PIPE, TILE, ETC. | CRUDE CLAY. | |
|---|---|---|---|---|---|
| | QUANTITY. | VALUE. | | TONS. | VALUE. |
| 1901 | 55,000 | $ 550 | $ 55,745 | ---------- | $ 100 |
| 1902 | ---------- | 1,203 | 72,618 | ---------- | 215 |
| 1903 | 407,500 | 5,250 | 100,989 | 231 | 875 |
| 1904 | 163,000 | 2,700 | 110,800 | 80 | 700 |
| 1905 | 681,000 | 8,333 | 102,445 | 57 | 494 |

## BRICK-CLAY.

### *Production.*

In nearly every county in North Carolina there are clay deposits suitable for the manufacture of common brick, these consisting of both residual and sedimentary clays. In some the deposits are very extensive from which excellent brick can be made. In many instances the brick-yards can be favorably located near railroad transportation, and fuel for burning the brick can usually be obtained at a very low price. Notwithstanding the advantages for brick manufacture in the State, the brick industry has not been as valuable as it should have been, and this is largely due to the lack of capital for installing machinery and also for lack of men experienced in brick manufacture. With the exception of fire-brick, the total number of brick manufactured in North Carolina during 1905 amounted to 154,885,000 valued at $913,814. This is an increase of 9,956,150 brick in quantity and of $97,095 in value as compared with 145,928,850 brick valued at $816,719, the production of 1904. The average value per thousand of the 1905 production was $5.89 as compared with $5.54, the average value per thousand of the 1904 production, this being an increase of 35 cents per thousand. There were 59 counties from which this production was obtained, which is two more than in 1904, which in turn was five less than in 1903. These counties—Carteret, Gates, Macon, Montgomery, and Transylvania—which reported a production of brick during 1904, reported none during 1905, while Anson, Franklin, Madison, Pender, Perquimans, Stokes, and Yadkin, which made no production during 1904, became producers in 1905. Of the 1905 production there were 153,610,000 common

brick valued at $896,289, which is an increase of 9,621,150 brick in quantity and of $100,795 in value as compared with 143,988,850 common brick valued at $795,494, the production of 1904. The number of pressed and fancy brick manufactured in 1905 was 875,000 valued at $13,925; and of vitrified brick 400,000 valued at $3,600, as compared with a production of 1,510,000 pressed brick valued at $17,375 and 430,000 vitrified brick valued at $3,850 in 1904. In the table below is given the quantity and value of common, pressed, vitrified, and fire brick produced during the past four years:

PRODUCTION OF COMMON, PRESSED, VITRIFIED, AND FIRE BRICK IN 1902, 1903, 1904, AND 1905.

| CHARACTER. | 1902. | | 1903. | | 1904. | | 1905. | |
|---|---|---|---|---|---|---|---|---|
| | QUANTITY. | VALUE. | QUANTITY. | VALUE. | QUANTITY. | VALUE. | QUANTITY. | VALUE. |
| Common brick | 131,618,700 | $694,827 | 136,822,900 | $731,802 | 143,988,850 | $795,494 | 153,610,000 | $896,289 |
| Pressed brick | 1,833,000 | 10,625 | 766,000 | 8,230 | 1,510,000 | 17,375 | 875,000 | 13,925 |
| Vitrified brick | 600,000 | 6,000 | 500,000 | 5,000 | 430,000 | 3,850 | 400,000 | 3,600 |
| Fire-brick | 120,000 | 1,203 | 407,500 | 5,250 | 163,000 | 2,700 | 681,000 | 8,333 |
| Total | 134,171,700 | 712,655 | 138,496,400 | 750,282 | 146,091,850 | 819,419 | 155,566,000 | 922,147 |

The average value per thousand received for common brick in 1905 was $5.83, which is 38 cents greater than the average value of $5.45 per thousand of the 1904 production. The lowest value per thousand reported as having been received for common brick during 1904 was $4, which was received for 50,000 brick manufactured in Wake County, and the highest value per thousand was $9, which was received for 800,000 brick from Robeson County. The brick manufactured in the extreme eastern counties bring a relatively higher value than those manufactured in any other section of the State, principally on account of the higher cost of the brick imported into these counties. The number of manufacturers engaged in making brick in 1905 was 164, which is 15 less than the number, 179, engaged in this business in 1904. One thing to be noticed in connection with the manufacture of brick in North Carolina is that the larger companies are increasing their production and there is beginning to be a falling off of the very small producers.

In the following tables the total number and value of the different varieties of brick, including fire-brick, manufactured in North Carolina are given for the years 1905 and 1904 by counties:

## NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1905, BY COUNTIES.

| COUNTY. | COMMON BRICK. | VALUE. | PRESSED BRICK. | VALUE. | VITRIFIED AND FIRE BRICK. | VALUE. |
|---|---|---|---|---|---|---|
| Alamance | 4,275,000 | $ 27,950 | | $ | | $ |
| Anson | 250,000 | 1,500 | | | | |
| Beaufort | 2,425,000 | 14,850 | | | | |
| Bertie | 75,000 | 450 | | | | |
| Bladen | 125,000 | 750 | | | | |
| Buncombe | 4,340,000 | 26,833 | 55,000 | 725 | 481,000 | 5,683 |
| Burke | 1,240,000 | 6,250 | | | | |
| Cabarrus | 8,200,000 | 53,200 | 500,000 | 10,000 | 500,000 | 6,250 |
| Caldwell | 3,300,000 | 16,500 | | | | |
| Catawba | 3,200,000 | 14,750 | | | | |
| Chatham | 300,000 | 1,500 | | | | |
| Chowan | 1,100,000 | 7,700 | | | | |
| Cleveland | 825,000 | 4,800 | | | | |
| Columbus | 2,075,000 | 12,500 | | | | |
| Craven | 8,764,000 | 48,765 | | | | |
| Cumberland | 3,000,000 | 16,500 | | | | |
| Davidson | 3,000,000 | 19,000 | | | | |
| Duplin | 40,000 | 263 | | | | |
| Durham | 9,475,000 | 57,063 | | | | |
| Edgecombe | 4,975,000 | 29,950 | 120,000 | 1,200 | | |
| Forsyth | 10,283,000 | 55,915 | | | | |
| Franklin | 2,300,000 | 14,500 | | | | |
| Gaston | 2,220,000 | 11,520 | | | | |
| Greene | 810,000 | 5,420 | | | | |
| Guilford | 8,133,000 | 47,799 | | | | |
| Halifax | 4,850,000 | 26,950 | | | | |
| Harnett | 100,000 | 700 | | | | |
| Haywood | 550,000 | 3,025 | | | | |
| Henderson | 1,000,000 | 5,000 | | | | |
| Iredell | 1,200,000 | 7,200 | | | | |
| Johnston | 3,515,000 | 22,240 | | | | |
| Lenoir | 700,000 | 3,500 | | | | |
| Lincoln | 20,000 | 120 | | | | |
| McDowell | 300,000 | 1,800 | 200,000 | 2,000 | | |
| Madison | 125,000 | 625 | | | | |
| Mecklenburg | 5,000,000 | 27,500 | | | | |
| Moore | 1,809,000 | 9,854 | | | | |
| Nash | 1,500,000 | 9,000 | | | | |
| New Hanover | 2,750,000 | 16,500 | | | | |
| Orange | 550,000 | 2,750 | | | | |
| Pasquotank | 2,400,000 | 13,600 | | | | |
| Pender | 500,000 | 3,000 | | | | |
| Perquimans | 190,000 | 1,330 | | | | |
| Pitt | 1,100,000 | 6,950 | | | | |
| Randolph | 2,396,000 | 13,183 | | | | |
| Robeson | 2,345,000 | 16,888 | | | | |
| Rockingham | 2,450,000 | 14,450 | | | | |
| Rowan | 3,760,000 | 21,800 | | | | |
| Rutherford | 435,000 | 2,556 | | | | |
| Scotland | 300,000 | 1,800 | | | | |
| Stokes | 1,000,000 | 7,000 | | | | |
| Surry | 870,000 | 5,080 | | | | |
| Union | 3,674,000 | 19,900 | | | | |
| Wake | 4,808,000 | 28,559 | | | | |
| Washington | 100,000 | 800 | | | | |
| Wayne | 10,750,000 | 59,563 | | | | |
| Wilkes | 1,500,000 | 9,000 | | | | |
| Wilson | 6,166,000 | 37,000 | | | | |
| Yadkin | 167,000 | 838 | | | | |
| Total | 153,610,000 | 896,289 | 875,000 | 13,925 | 981,000 | 11,933 |

## NUMBER AND VALUE OF BRICK MADE IN NORTH CAROLINA DURING 1904, BY COUNTIES.

| COUNTY. | COMMON BRICK. | VALUE. | PRESSED BRICK. | VALUE. | VITRIFIED AND FIRE BRICK. | VALUE. |
|---|---|---|---|---|---|---|
| Alamance | 4,440,000 | $ 25,750 | | $ | | $ |
| Beaufort | 2,840,000 | 17,000 | | | 30,000* | 300 |
| Bertie | 1,475,000 | 8,850 | | | | |
| Bladen | 300,000 | 1,800 | | | | |
| Buncombe | 3,575,000 | 18,860 | 100,000 | 1,250 | 153,000† | 2,600 |
| Burke | 550,000 | 2,800 | | | | |
| Cabarrus | 5,350,000 | 26,750 | 100,000 | 1,000 | | |
| Caldwell | 2,200,000 | 8,800 | | | | |
| Carteret | 341,000 | 1,850 | | | | |
| Catawba | 1,960,000 | 10,045 | | | | |
| Chatham | 151,000 | 708 | | | | |
| Chowan | 1,000,000 | 7,000 | | | | |
| Cleveland | 915,000 | 4,800 | | | | |
| Columbus | 2,000,000 | 10,300 | | | | |
| Craven | 8,639,000 | 47,515 | | | | |
| Cumberland | 1,750,000 | 9,500 | | | | |
| Davidson | 1,075,000 | 5,300 | 5,000 | 75 | | |
| Duplin | 26,000 | 174 | | | | |
| Durham | 3,665,000 | 19,625 | | | | |
| Edgecombe | 6,075,000 | 36,200 | | | | |
| Forsyth | 5,380,000 | 28,540 | | | | |
| Gaston | 3,500,000 | 19,400 | | | | |
| Gates | 90,000 | 270 | | | | |
| Greene | 60,000 | 420 | | | | |
| Guilford | 13,450,000 | 78,368 | 50,000 | 500 | 100,000* | 850 |
| Halifax | 4,100,000 | 24,000 | 125,000 | 1,250 | | |
| Harnett | 250,000 | 1,450 | | | | |
| Haywood | 800,000 | 4,400 | | | | |
| Henderson | 2,000,000 | 10,000 | 30,000 | 300 | 300,000* | 2,700 |
| Iredell | 995,000 | 5,250 | | | | |
| Johnston | 2,840,000 | 15,800 | | | | |
| Lenoir | 500,000 | 2,000 | | | | |
| Lincoln | 1,225,000 | 6,300 | | | | |
| McDowell | 450,000 | 2,700 | 200,000 | 2,000 | | |
| Macon | 150,000 | 750 | | | | |
| Mecklenburg | 3,500,000 | 21,000 | | | | |
| Montgomery | 10,000 | 40 | | | | |
| Moore | 2,900,000 | 16,400 | | | | |
| Nash | 1,300,000 | 7,800 | | | | |
| New Hanover | 2,750,000 | 17,125 | 800,000 | 10,000 | | |
| Orange | 1,217,000 | 6,628 | | | | |
| Pasquotank | 1,900,000 | 10,800 | | | | |
| Pitt | 2,200,000 | 13,200 | | | | |
| Randolph | 990,000 | 5,266 | | | 10,000† | 100 |
| Robeson | 1,805,000 | 10,788 | | | | |
| Rockingham | 7,580,000 | 38,075 | 100,000 | 1,000 | | |
| Rowan | 4,100,000 | 23,000 | | | | |
| Rutherford | 1,000,000 | 5,700 | | | | |
| Scotland | 500,000 | 3,000 | | | | |
| Surry | 1,325,000 | 6,375 | | | | |
| Transylvania | 125,000 | 750 | | | | |
| Union | 4,879,000 | 24,768 | | | | |
| Wake | 5,717,850 | 31,479 | | | | |
| Washington | 300,000 | 2,400 | | | | |
| Wayne | 9,000,000 | 49,625 | | | | |
| Wilkes | 1,500,000 | 7,500 | | | | |
| Wilson | 5,273,000 | 30,500 | | | | |
| Total | 143,988,850 | 795,494 | 1,510,000 | 17,375 | 593,000 | 6,550 |

*Vitrified brick.

† Fire brick.

The 1905 production was obtained from 78 counties as compared with 76 counties in 1904, and in the following table the value of the productions for the years 1905 and 1904 in each county is given:

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1904 AND 1905.

| County. | 1904. | | | 1905. | | |
|---|---|---|---|---|---|---|
| | Mineral production, including kaolin. | Clay products, except kaolin. | Total. | Mineral production, including kaolin. | Clay products, except kaolin. | Total. |
| Alamance | $ 24 | $ 25,750 | $ 25,774 | $ | $ 27,950 | $ 27,950 |
| Alexander | 150 | | 150 | 600 | | 600 |
| Alleghany | | | | | | |
| Anson | 304 | | 304 | | 1,500 | 1,500 |
| Ashe | 175 | | 175 | 830 | | 830 |
| Beaufort | | 17,500 | 17,500 | | 15,250 | 15,250 |
| Bertie | | 8,850 | 8,850 | | 450 | 450 |
| Bladen | | 1,800 | 1,800 | | 750 | 750 |
| Brunswick | | | | | | |
| Buncombe | 24,728 | 23,471 | 48,199 | 35,607 | 36,785 | 72,392 |
| Burke | 26,806 | 2,800 | 29,606 | 1,015 | 6,250 | 7,265 |
| Cabarrus | 15,083 | 27,750 | 42,833 | 23,489 | 69,450 | 92,939 |
| Caldwell | 10,047 | 8,800 | 18,847 | | 16,500 | 16,500 |
| Camden | | | | | | |
| Carteret | | 1,850 | 1,850 | | | |
| Caswell | | | | | | |
| Catawba | 5,544 | 14,520 | 20,064 | 3,581 | 16,705 | 20,286 |
| Chatham | 8,918 | 1,308 | 10,226 | 2,336 | 2,000 | 4,336 |
| Cherokee | 45,211 | | 45,211 | 29,459 | | 29,459 |
| Chowan | | 7,000 | 7,000 | | 7,700 | 7,700 |
| Clay | 2,458 | | 2,458 | 7,500 | | 7,500 |
| Cleveland | 32,682 | 4,800 | 37,482 | 73,017 | 4,800 | 77,817 |
| Columbus | | 10,300 | 10,300 | | 12,500 | 12,500 |
| Craven | | 47,515 | 47,515 | | 48,765 | 48,765 |
| Cumberland | | 9,500 | 9,500 | | 16,500 | 16,500 |
| Currituck | | | | | | |
| Dare | | | | | | |
| Davidson | 1,694 | 5,375 | 7,069 | 1,420 | 19,000 | 20,420 |
| Davie | | | | 3,850 | | 3,850 |
| Duplin | | 174 | 174 | | 263 | 263 |
| Durham | | 19,625 | 19,625 | | 57,063 | 57,063 |
| Edgecombe | | 36,200 | 36,200 | | 31,150 | 31,150 |
| Forsyth | | 28,840 | 28,840 | | 56,015 | 56,015 |
| Franklin | 90 | | 90 | | 14,500 | 14,500 |
| Gaston | 1,111 | 19,400 | 20,511 | 3,365 | 11,520 | 14,885 |
| Gates | | 270 | 270 | | | |
| Graham | | | | | | |
| Granville | 1,799 | | 1,799 | 12,000 | | 12,000 |
| Greene | | 420 | 420 | | 5,420 | 5,420 |
| Guilford | 12,899 | 189,718 | 202,617 | 9,108 | 145,299 | 154,407 |
| Halifax | 180 | 25,250 | 25,430 | | 26,950 | 26,950 |
| Harnett | | 1,450 | 1,450 | | 700 | 700 |
| Haywood | 36,500 | 4,400 | 40,900 | 35,210 | 3,025 | 38,235 |
| Henderson | 11,295 | 13,000 | 24,295 | 11,880 | 5,000 | 16,880 |
| Hertford | | | | | | |
| Hyde | | | | | | |
| Iredell | 240 | 5,250 | 5,490 | 2,063 | 7,200 | 9,263 |
| Jackson | 76,854 | | 76,854 | 79,350 | | 79,350 |
| Johnston | | 16,150 | 16,150 | | 22,490 | 22,490 |
| Jones | | | | | | |
| Lenoir | | 2,000 | 2,000 | | 3,500 | 3,500 |
| Lincoln | 1,841 | 10,270 | 12,111 | | 2,199 | 2,199 |
| McDowell | 27,190 | 4,700 | 31,890 | 20,153 | 3,800 | 23,953 |
| Macon | 47 | 750 | 797 | 2,000 | | 2,000 |
| Madison | 37,986 | | 37,986 | 23,185 | 625 | 23,810 |
| Martin | | | | | | |
| Mecklenburg | 1,183 | 21,000 | 22,183 | 7,462 | 27,500 | 34,962 |
| Mitchell | 109,466 | | 109,466 | 89,927 | | 89,927 |
| Montgomery | 51,362 | 390 | 51,752 | 62,650 | | 62,650 |

VALUE OF MINERAL PRODUCTION BY COUNTIES IN NORTH CAROLINA IN 1904 AND 1905—CONTINUED.

| COUNTY. | 1904. | | | 1905. | | |
|---|---|---|---|---|---|---|
| | MINERAL PRODUCTION, INCLUDING KAOLIN. | CLAY PRODUCTS, EXCEPT KAOLIN. | TOTAL. | MINERAL PRODUCTION, INCLUDING KAOLIN. | CLAY PRODUCTS, EXCEPT KAOLIN. | TOTAL. |
| Moore | $ 5,860 | $ 16,400 | $ 22,260 | $ 13,682 | $ 9,954 | $ 23,636 |
| Nash | 45 | 7,800 | 7,845 | 2,006 | 9,000 | 11,006 |
| New Hanover | 12,346 | 27,125 | 39,471 | 34,405 | 16,500 | 50,905 |
| Northampton | | | | | | |
| Onslow | | | | | | |
| Orange | 10,617 | 6,628 | 17,245 | 13,340 | 2,750 | 16,090 |
| Pamlico | | | | | | |
| Pasquotank | | 10,800 | 10,800 | | 13,600 | 13,600 |
| Pender | | | | | 3,000 | 3,000 |
| Perquimans | | | | | 1,330 | 1,330 |
| Person | 15,506 | | 15,506 | | | |
| Pitt | | 13,200 | 13,200 | | 6,950 | 6,950 |
| Polk | 13,738 | | 13,738 | 25,703 | | 25,703 |
| Randolph | 26,236 | 6,481 | 32,717 | | 14,093 | 14,093 |
| Richmond | 770 | | 770 | 2,000 | | 2,000 |
| Robeson | | 10,788 | 10,788 | 1,000 | 16,888 | 17,888 |
| Rockingham | | 39,075 | 39,075 | | 14,450 | 14,450 |
| Rowan | 127,774 | 23,000 | 150,774 | 334,454 | 21,800 | 356,254 |
| Rutherford | 5,904 | 5,700 | 11,604 | 34,320 | 2,556 | 36,876 |
| Sampson | | | | | | |
| Scotland | | 3,000 | 3,000 | 4,450 | 1,800 | 6,250 |
| Stanly | 17,271 | | 17,271 | 10,140 | | 10,140 |
| Stokes | | | | 3,000 | 7,000 | 10,000 |
| Surry | 110,466 | 6,375 | 116,841 | 219,883 | 5,080 | 224,963 |
| Swain | 57,258 | | 57,258 | 65,212 | | 65,212 |
| Transylvania | | 750 | 750 | 600 | | 600 |
| Tyrrell | | | | | | |
| Union | 9,992 | 25,168 | 35,070 | 4,977 | 22,400 | 27,377 |
| Vance | 8,000 | | 8,000 | 7,150 | | 7,150 |
| Wake | 525 | 31,479 | 32,004 | 475 | 32,684 | 33,159 |
| Warren | 361 | | 361 | 38,010 | | 38,010 |
| Washington | | 2,400 | 2,400 | | 800 | 800 |
| Watauga | | | | 350 | | 350 |
| Wayne | | 49,625 | 49,625 | 3,185 | 59,563 | 62,748 |
| Wilkes | | 8,694 | 8,694 | 63 | 11,320 | 11,383 |
| Wilson | | 30,500 | 30,500 | | 37,000 | 37,000 |
| Yadkin | | | | | 838 | 838 |
| Yancey | 35,300 | | 35,300 | 39,300 | | 39,300 |
| Unknown | 1,047 | | 1,047 | 2,189 | | 2,189 |
| Totals | 1,001,393 | 944,880 | 1,946,273 | 1,400,951 | 1,038,430 | 2,439,381 |

The value of the clay products, with the exception of kaolin, which is included with "Other Minerals," is given separately from the rest of the mineral production. As is seen from the above table, the following counties reported no production of mineral of any kind during 1905: Alleghany, Brunswick, Camden, Carteret, Caswell, Currituck, Dare, Gates, Graham, Hertford, Hyde, Jones, Martin, Northampton, Onslow, Pamlico, Person, Sampson, Tyrrell. Of these counties the following reported a production in 1904: Carteret, Gates, and Person. There were 5 counties, Davie, Perquimans, Stokes, Watauga, and Yadkin, which reported a production in 1905, but none in 1904.

Of the 78 counties reporting a mineral production for 1905, there were only 48 counties that reported anything besides clay products. Of the 59 counties reporting a production of clay, 16 counties did not report any other production. There were 20 counties reporting a mineral production which did not include any clay products. Rowan County reported the greatest value for its mineral production, excepting clay products, the value being $334,454; while Guilford County reported the greatest value of clay products, $145,299. The county reporting the greatest value for its total mineral production in 1905 was Rowan, with a value of $356,254. Surry County was second in the value of its total mineral production, which was $224,963. The lowest value reported by any county for its mineral production was $263 from Duplin County.

## BLACK SAND INVESTIGATIONS.

### CONCENTRATING PLANT.

There is now being installed at Chapel Hill, North Carolina, by the United States Geological Survey in coöperation with the North Carolina Geological and Economic Survey, a concentrating plant, whose primary object is a comprehensive investigation of the useful minerals contained in placer deposits, especially those containing what is known as the black sands; and in the sands along the Atlantic seacoast. The plant will also be used to test the pulp obtained by crushing ores from deep mines. Its object is really twofold, that of testing the gravels and ores and also of comparative tests of different concentrators, magnetic separators, etc., in order to determine satisfactory methods for concentrating these sands and separating the different minerals. The plant will be similar to the one erected at Portland, Oregon, during the Lewis and Clark Exposition, and which was maintained there by the United States Geological Survey to the first of October, 1906. Various concentrating tables, such as the Wifley, loaned by the Mines and Smelter Supply Company of Denver, Standard, etc., will be installed; also Wetherill and Blake-Morscher magnetic separators, loaned by the Wetherill Magnetic Separator Company of New York, and the Blake Mining and Milling Company of Denver, respectively; ore crushers, rolls and classifiers, which will permit of the treatment of any of the ores and gravels in order to determine exactly their mineral contents. A storage battery that has been built and loaned by the Electric Storage Battery Company of Philadelphia has also been installed.

The power for the plant will be generated by a gasoline engine loaned by the Fairbanks-Morse Company of Chicago. In connection with the concentrating plant there will be a well-equipped and complete assay laboratory, so that the actual values of gold, silver, platinum, and other metals that the ores may contain can be determined.

Many of these gravel deposits and sands contain, besides the precious metals, gold, silver, platinum, such minerals as magnetite, chromite, ilmenite, monazite, garnet, chrysolite, zircon, quartz, etc., which by means of the various machines can be separated not only from the precious metals, but from each other. Some of these minerals have a decided commercial value, and, as they can be separated from each other so as to give an almost pure product of each, they can be obtained in a marketable condition. There is more or less demand for them, depending upon the quantity of each that can be obtained. For the magnetite and ilmenite there may be an opening for use by the various electrical companies, such as the General Electric Company. The chromite, if it occurs in quantity in the sands, would have a decided value for use in the manufacture of chrome steel and chrome salts. Monazite and zircon have already been referred to in this report. The garnet, under certain conditions, would be of value for abrasive purposes.

It has been proved that it is possible to clean quartz sands, such as occur along seashores, so as to obtain a sufficiently pure sand for use in the manufacture of glass.

The method of treatment of the ore will of course vary greatly with the kind of sand. In this work the sands will be grouped into two general classes, (1) sea sands, river sands, and sand-dune material; and (2) low-grade gravels, tailings from dredges and placer workings and richer heavy tailings from the cleanup from sluice-boxes, dredges, etc. Another class of material that will be tested will be pulp from the crushing of various ores.

The samples will be assayed and then screened. The oversize will be examined and the undersize delivered to the concentrating tables, where it will be separated into three portions, concentrates, middlings, and tailings. These separate portions are all carefully examined and the concentrates will be separated on the Wetherill and Blake-Morscher magnetic separators. The Wetherill magnetic separator will separate the concentrates into six portions by five successively increased strengths of current. These minerals group themselves together in separate portions as follows: (1) magnetite, (2) chro-

mite and ilmenite, (3) garnet, (4) olivine, hypersthene, and similar heavy silicates, (5) monazite and (6) non-magnetic residue containing zircon, quartz, iridium, iridosmium, gold and some of the platinum.

It is expected that the concentrating plant will be ready for operation soon after the first of January, and then samples of gravel and concentrates from 100 pounds up to 10 tons can be tested. Before any large samples are sent, however, small 4-pound samples should be forwarded for testing to determine whether they are worthy of further investigation. Those that give indications of containing minerals of economic value in commercial quantity will then be tested in larger quantity to determine the method of separation, etc. The following letter has been sent out regarding the forwarding of 4-pound samples to this office:

DEAR SIR:—The concentrating plant of the United States Geological Survey has just been established at Chapel Hill for testing the heavy sands (so-called black sands) of the Southern Appalachian region. Such sands are collected in the riffles in gold, monazite, and other placer mining. The Geological Survey has, in coöperation with the North Carolina Geological and Economic Survey, undertaken the examination of these heavy sands in order to determine what minerals they contain and if any of these are of economic importance. Tests will also be made as to the best methods of extracting these various minerals such as magnetite, chromite, garnet, monazite, rutile, topaz, zircon, gold, platinum, iridosmium, etc., the separation of some of which may prove to be permanent and profitable industries. The value of gold and silver in all the sands will be determined.

As a preliminary step in this investigation, will you mail to this office, using the accompanying franked envelope (which requires no postage) not more than four (4) pounds of the heavy sands which occur in your placer deposit? This material should be concentrated as well as you can do so before mailing in order to eliminate, as far as possible, the lighter minerals. As far as possible, you should send a record of the clay and the original gravel from which the concentrates were obtained; also exact information as to the name and post-office address of the sender, the name of the mine from which it came and the State, county, city, village, or district in which the deposit is located.

Care should be used to pack the dried sand securely for transmission through the mails, preferably by sewing up the sand in the bag and tying the envelope carefully to the bag. Do not send any samples of sand except where the sand occurs in sufficient quantity so that a ton or a car-load could be obtained, if desired.

Do not send any large samples of sand until instructed to do so by this office.

Yours very truly, JOSEPH HYDE PRATT,
*Director of Concentrating Plant.*

There are now over one hundred of these samples on hand, which will be tested shortly and the results obtained will determine the larger samples that will be asked for.

# MINING LAWS OF NORTH CAROLINA.

On account of the many inquiries that have been received requesting information relating to the Mining Laws of North Carolina, the laws touching on this subject, as given in the Revisal of 1905, have been collected and are given in the following pages:

## MINES.*

### I. OPERATORS.

4930. *Lessor not held partner of lessee.* No lessor of property, real or personal, for mining purposes, although the lessor may receive a sum uncertain of the proceeds or net profits, or any other consideration, which, though uncertain at first, may afterwards become certain, shall be held as a partner of the lessee; nor shall any of the legal or equitable relations or liabilities of copartners exist between them, unless it be so stipulated in the contract between the lessor and lessee.

Code, s. 3292; R. C., c. 72; 1830, c. 46.

4931. *Not to employ minors under twelve.* No minor under twelve years of age shall be allowed to work in any mine, and in all cases of minors applying for work the agent of such mine shall see that the provisions of this section are not violated; and the inspector may, when doubt exists as to the age of any person found working in any mine, examine under oath such person and his parents, or other witnesses, as to his age.

1897, c. 251, s. 7.

4933. *To fence unused mines.* All underground entrances to any place not in actual course of working or extension shall be properly fenced across the whole width of such entrance so as to prevent persons from inadvertently entering the same.

1897, c. 251, s. 5.

4935. *Hoisting engines, how operated.* No owner or agent of any mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of mines persons employed therein any but experienced, competent, and sober engineers, and no engineer in charge of such engine shall allow any person except such as may be deputed for such purposes by the owner or agent to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties, and in no case shall more than two men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

1897, c. 251, s. 6.

4939. *Notice of opening or changing mines given.* The owner, agent or manager of any mine shall give notice to the inspector in the following cases:

* Chapter 103, Revisal of 1905.

1. When any working is commenced for the purpose of opening a new shaft, slope or mine, to which this chapter applies. 2. When any mine is abandoned, or the working thereof discontinued. 3. When the working of any mine is recommenced after an abandonment or discontinuance for a period exceeding three months. 4. When a squeeze or crush, or any other cause or change, may seem to affect the safety of persons employed in the mine, or when fire occurs.

1897, c. 251, s. 7.

ACCIDENTS IN MINES.

4940. *Accidents; notice of, given.* The owner, agent, or manager of every mine shall, within twenty-four hours next after any accident or explosion, whereby loss of life or personal injury may have been occasioned, send notice, in writing, by mail or otherwise, to the inspector, and shall specify in such notice the character and cause of the accident, and the name or names of the persons killed, and injured, with the extent and nature of the injuries sustained. When any personal injury of which notice is required to be sent under this section results in the death of the person injured, notice in writing shall be sent to the inspector within twenty-four hours after such death comes to the knowledge of the owner, agent, or manager, and when such loss of life occurs in any mine by explosion, or accident, or results from personal injuries so received, the owner, agent, or manager of such mine shall notify the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person whose death has been thus caused, and inquire carefully into the cause thereof, and return a copy of the finding of the jury and all the testimony to the inspector.

1897, c. 251, s. 6.

4941. *Report to inspector.* The owner, lessee or agent in charge of any mine, any limestone quarry, or who is engaged in mining or producing any mineral whatsoever in this State, shall, on or before the thirtieth day of November in every year, send to the office of the inspector upon blanks to be furnished by him a correct return, specifying with respect to the year ending on the preceding first day of October the quantity of coal, iron ore, fire-clay, limestone, or other mineral product of such mine or quarry, and the number of persons ordinarily employed in or about such mine or quarry, below and above ground, distinguishing the persons and labor below ground and above ground.

1897, c. 251, s. 3.

4942. *Liable for injuries.* For any injury to person or property occasioned by any wilful violation of this chapter, or any wilful failure to comply with its provisions, by any owner, agent or manager of the mine, a right of action shall accrue to the party injured for any damage he may have sustained thereby; and in any case of loss of life by reason of such wilful neglect or failure aforesaid a right of action shall accrue to the personal representative of the deceased, as in other actions for wrongful death.

1897, c. 251, s. 6.

II. INSPECTOR.

4943. *Commissioner of Labor and Printing is, ex officio.* The Commissioner of Labor and Printing shall perform the duties of mine inspector as provided in this chapter.*

1897, c. 251, s. 1.

* See Section 3910 of Chapter 84 of Revisal of 1905, Vol. II.

4944. *To examine mines.* It shall be the duty of the inspector to examine all the mines in the State as often as possible to see that all the provisions and requirements of this chapter are strictly observed and carried out; he shall particularly examine the works and machinery belonging to any mine, examine into the state and conditions of the mines as to ventilation, circulation, and condition of air, drainage, and general security.

1897, c. 251, s. 2.

4945. *May enter to make examinations.* For the purpose of making the inspection and examinations provided for in this chapter, the inspector shall have the right to enter any mine at all reasonable times, by night or by day, but in such manner as shall not unnecessarily obstruct the working of the mine; and the owner or agent of such mine is hereby required to furnish the means necessary for such entry and inspection; the inspection and examination herein provided for shall extend to fire-clay, iron ore, and other mines, as well as coal mines.

1897, c. 251, s. 2.

4946. *Death by accident investigated.* Upon receiving notice of any death resulting from accident it shall be the duty of the inspector to go himself, or to send a representative, at once to the mine in which said death occurred, and inquire into the cause of the same, and to make a written report fully setting forth the condition of that part of the mine where such death occurred and the cause which led to the same; which report shall be filed by the inspector in his office as a matter of record, and for future reference.

1897, c. 251, s. 6.

4947. *Keep record of examinations.* He shall make a record of all examinations of mines, showing the date when examination made, the condition in which the mines are found, the extent to which the laws relating to mines and mining are observed or violated, the progress made in the improvements and security of life and health sought to be secured by the provisions of this chapter, number of accidents, injuries received or deaths in or about the mines, the number of mines in the State, the number of persons employed in or about each mine, together with all such other facts and information of public interest, concerning the condition of mines, development and progress of mining in the State as he may think useful and proper, which record shall be filed in the office of the inspector, and as much thereof as may be of public interest to be included in his annual report.

1897, c. 251, s. 2.

4948. *Preserve papers.* He shall keep in his office and carefully preserve all maps, surveys, and other reports and papers required by law to be filed with him, and so arrange and preserve the same as shall make them a permanent record of ready, convenient, and connected reference.

1897, c. 251, s. 3.

4949. *To enforce law; counsel furnished.* In case of any controversy or disagreement between the inspector and the owner or operator of any mine or the persons working therein, or in case of conditions or emergencies requiring counsel, the inspector may call on the Governor for such assistance and counsel as may be necessary. Should the inspector find any of the provisions of this chapter violated or not complied with by any owner, lessee or agent in charge, unless the same is within a reasonable time rectified, and the provisions of this chapter fully com-

plied with, he shall institute an action in the name of the State to compel the compliance therewith. The inspector shall exercise a sound discretion in the enforcement of this chapter.

1897, c. 251, s. 2.

4950. *Enjoin operations when law violated.* On application of the inspector, after suit brought as directed in the preceding section, any court of competent jurisdiction may enjoin or restrain the owner or agent from working or operating such mine until it is made to conform to the provisions of this chapter; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

1897, c. 251, s. 7.

4951. *Report to Governor.* The inspector shall annually make report to the governor of all his proceedings, the condition and operation of the different mines of the State, and the number of mines and the number of persons employed in or about such mines, the amount of coal, iron ore, limestone, fire-clay or other mineral mined in this State; and he shall enumerate all accidents in or about the mines, and the manner in which they occurred, and give all such other information as he thinks useful and proper, and make such suggestions as he deems important relative to mines and mining, and any legislation that may be necessary on the subject for the better preservation of the life and health of those engaged in such industry.

1897, c. 251, s. 3.

4952. *To what applicable.* The provisions of this chapter shall not apply to or affect any mine in which not more than ten men are employed at the same time; but the inspector shall at all times have free ingress to such mines for the purpose of examination, and shall direct and enforce any regulation in accordance with the provisions of this chapter that he may deem necessary for the safety of the health and lives of the miners employed therein.

1897, c. 251, s. 8.

### III. Waterways Obtained.

4953. *Water and drainage rights, how obtained.* Any person or body corporate engaged or about to engage in mining, who may find it necessary for the furtherance of his operations to convey water either to or from his mine or mines over the lands of any other person or persons, may make application by petition in writing to the clerk of the superior court of the county in which the lands to be affected or the greater part are situate, for the right so to convey such water. The owner of the lands to be affected shall be made a party defendant and the proceeding shall be conducted as other special proceedings.

Code, ss. 3293, 3294, 3300; 1871-2, c. 158, ss. 1. 3.

4954. *The petition, what to contain.* The petition shall specify the lands to be affected, the name of the owner of such lands, and the character of the ditch or drain intended to be made.

Code, s. 3294; 1871-2, c. 158, s. 3.

4955. *Appraisers; appointment, duties and pay of.* Upon the hearing of the petition, if the prayer thereof be granted, the clerk shall appoint three disinterested persons, qualified to act as jurors, and not connected either by blood or marriage

with the parties, appraisers to assess the damage, if any, that will accrue to the lands by the contemplated work, and shall issue a notice to them to meet upon the premises at a day specified, not to exceed ten days from the date of such notice. The appraisers having met, shall take an oath before some officer qualified to administer oaths to faithfully perform their duty and to do impartial justice in the case, and shall then examine all the lands in any way to be affected by such work, and assess the damage thereto, and make report thereof under their hands and seals to the clerk from whom the notice issued.

Code, ss. 3295, 3296, 3299; 1871-2, c. 158, ss. 4, 5, 9.

4956. *Confirmation of report; payment of damages; rights of petitioner.* After the filing of the report and confirmation thereof by the clerk, who shall have power to confirm or, for good cause, set aside the same, the petitioner shall have full right and power to enter upon such lands and make such ditches, drains or other necessary work: *Provided,* he has first paid or tendered the damages, assessed as above, to the owner of such lands or his known and recognized agent, if he be a resident of this State, or have such agent in this State. If the owner be a non-resident and have no agent in this State, the amount so assessed shall be paid by the petitioner into the office of the Clerk of the Superior Court of the county for the use of such owner.

Code, s. 3297; 1871-2, c. 158, s. 7.

4957. *Registration of report.* The petitioner, or any other person interested, may have the report of the appraisers registered upon the certificate of the Clerk, and shall pay the Register a fee of twenty-five cents therefor.

Code, s. 3298; 1871-2, c. 158, s. 8.

## SPECIAL LAWS RELATING TO COAL MINES.*

4932. *To furnish timber.* The owner, agent or operator of every coal mine shall keep a supply of timber constantly on hand, and shall deliver the same to the working place of the miner, and no miner shall be held responsible for accident which may occur in the mine where the provisions of this section have not been complied with by the owner, agent or operator thereof, resulting directly from the failure to deliver such timber.

1897, c. 251, s. 8.

4934. *Means of ingress and egress provided.* No owner or agent of any coal mine worked by shaft shall permit any person to work therein unless there are, to every seam of coal worked in such mine, at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it is not necessary for the two outlets to belong to the same mine if the persons employed therein have safe, ready and available means of ingress or egress by not less than two openings. This section shall not apply to opening a new mine while being worked for the purpose of making communications between said two outlets, so long as not more than twenty persons are employed at one time in such mine; neither shall it apply to any mine or part of a mine in which the second outlet has been rendered unavailable by reason of the final robbing of pillars previous to abandonment, as long as not more than twenty persons are employed therein at any one time. The cage or cages and other

* Part of Chapter 103, Revisal of 1905.

means of egress shall at all times be available for the persons employed when there is no second outlet. The escapement shafts shall be fitted with safe and available appliances, which shall always be kept in a safe condition, by which the persons employed in the mine may readily escape in case an accident occurs; and in no case shall an air-shaft with a ventilating furnace at the bottom be construed to be an escapement shaft within the meaning of this section. To all other coal mines, whether slopes or drifts, two such openings or outlets must be provided within twelve months after shipments of coal have commenced from such mine; and in case such outlets are not provided as herein stipulated, it shall not be lawful for the agent or owner of such slope or drift to permit more than ten persons to work therein at any one time.

1897, c. 251, s. 4.

4936. *Ventilation.* The owner or agent of any coal mine, whether shaft, slope or drift, shall provide and maintain for every such mine an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, which shall be circulated and distributed throughout the mine in such a manner as to dilute, render harmless and expel the poisonous and noxious gases from each and every working place in the mine, and no working place shall be driven more than sixty feet in advance of a break-through or airway, and all break-throughs or airways, except those last made near the working places of the mine, shall be closed up by brattice trap-doors, or otherwise, so that the currents of air in circulation in the mine may spread to the interior of the mine when the persons employed in such mine are at work, and all mines governed by this chapter shall be provided with artificial means of producing ventilation, such as forcing or suction fans, exhaust steam furnaces, or other contrivances of such capacity and power as to produce and maintain an abundant supply of air, and all mines generating fire-damp shall be kept free from standing gas.

1897, c. 251, s. 5.

4937. *Daily examinations; safety lamps.* Every working place shall be examined every morning with a safety lamp by a competent person before any workmen are allowed to enter the mine. All safety lamps used in examining mines, or for working therein, shall be the property of the operator of the mine, and a competent person shall be appointed, who shall examine every safety lamp before it is taken into the workings for use, and ascertain it to be clean, safe and securely locked, and safety lamps shall not be used until they have been so examined and found safe and clean and securely locked, unless permission be first given by the mine foreman to have the lamps used unlocked. No one, except the duly authorized person, shall have in his possession a key, or any other contrivance, for the purpose of unlocking any safety lamp in any mine where locked lamps are used. No matches or any other apparatus for striking lamps shall be taken into any mines, or parts thereof, except under the direction of the mine foreman.

1897, c. 251, ss. 5, 6.

4938. *Report of ventilation.* The mine foreman shall measure the ventilation at least once a week, at the inlet and outlet, and also at or near the face of all the entries, and the measurement of air so made shall be noted on blanks furnished by the inspector; and on the first day of each month the mine boss of each mine shall sign one of such blanks, properly filled with the said actual measurement, and present the same to the inspector.

1897, c. 251, s. 6.

## GENERAL LAWS RELATING TO MINING.

3380. *Drains, obstructing, when necessary for mining.* If any person shall obstruct any drain or ditch constructed under the provisions of the law in regard to mines, he shall be guilty of a misdemeanor.

Code, s. 3301; 1871-2, c. 158, s. 12.

3797. *Mines.* If any person shall knowingly violate any of the provisions of the law relating to mines or shall do anything whereby the life or health of persons or the security of any mine and machinery is endangered, or if any miner or other person employed in any mine governed by the statutes shall intentionally or wilfully neglect or refuse to securely prop the roof of any working place under his control, or neglect or refuse to obey any orders given by the superintendent of a mine in relation to the security of a mine in the part thereof where he is at work and for fifteen feet back of his working place, or if any miner, workman or other person shall knowingly injure any water-guage, barometer, air-course or brattice, or shall obstruct or throw open any airways, or shall handle or disturb any part of the machinery of the hoisting engine or signaling apparatus or wire connected therewith, or air-pipes or fittings, open a door of the mine, and not have the same closed again, whereby danger is produced either to the mine or those that work therein, or shall enter any part of the mine against caution, or shall disobey any order given in pursuance of law, or shall do any wilful act whereby the lives and health of the persons working in the mines or the security of the mine or the machinery thereof is endangered, or if the person having charge of a mine whenever loss of life occurs by accident connected with the machinery of such mine or by explosion shall neglect or refuse to give notice thereof forthwith by mail or otherwise to the inspector and to the coroner of the county in which such mine is situated, or if any such coroner shall neglect or refuse to hold an inquest upon the body of the person whose death has been thus caused, and return a copy of his findings and a copy of all the testimony to the inspector, he shall be guilty of a misdemeanor, and upon conviction fined not less than fifty dollars or imprisoned in the county jail not more than thirty days, or both.

1897, c. 251, s. 8.

2000. *Mining and timber land leases.* If in a lease of land for mining, or of timbered land for the purpose of manufacturing the timber into goods, rent shall be reserved, and if it shall be agreed in the lease that the minerals, timber or goods, or any portion thereof, shall not be removed until the payment of the rent, in such case the lessor shall have the rights and be entitled to the remedy given by this chapter.*

Code, s. 1763; 1868-9, c. 156, s. 16.

## MINERAL INTEREST IN LAND.

2488. *Separate partition of surface and mineral interests.* When the title to the mineral interests in any land has become separated from the surface in ownership the tenants in common of such mineral interests may have partition of the same, distinct from the surface, and without joining as parties the owner or owners of the surface; and the tenants in common of the surface may have partition of the same in manner provided by law, distinct from the mineral interests and without joining as parties the owner or owners of the mineral interests. And in all

* Section from Chapter 46, on Landlord, etc.

instances where the mineral interests and surface interests have thus become separated in ownership, the owner or owners of the mineral interests shall not be compelled to join in a partition of the surface interests, nor shall the owner or owners of the surface interests be compelled to join in a partition of the mineral interests, nor shall the rights of either owner be prejudiced by a partition of the other interests.

1905, c. 90.

2507. *Sale of mineral interests.* In case of the partition of mineral interests, in all instances where it shall be made to appear to the Court that it would be for the best interest of the tenants in common of such interests to have the same sold, or if actual partition of the same cannot be had without injury to some or all of such tenants in common, then it shall be lawful for and the duty of the Court to order a sale of such mineral interests and a division of the proceeds as the interests of the parties may appear.

1905, c. 90, s. 2.

## LAWS RELATING TO PHOSPHATE ROCK.

1751. *Phosphate rock under navigable waters, when entered.* Any resident of this State who shall make affidavit before the Clerk of the Superior Court of any county through which such navigable stream may flow, that he has discovered in any navigable stream or waters of this State any phosphate rock or phosphate deposit therein, shall have authority and power to enter under the entry laws of this State so much of the bed of any such navigable stream or waters as shall not exceed in any one entry two miles in length up the middle of any such stream or water for the purpose of digging, mining or removing any such deposit or rock.

1891, c. 476.

1752. *How grant obtained; term; royalty.* Upon such affidavit being filed with the entry-taker, and upon a survey and plot being made of such entry by the county surveyor, as is now required by law in cases of entry of land, being made and certified to the Secretary of State with a copy of such affidavit and entry so made, the said Secretary of State shall issue a patent or grant to the said person, his heirs or assigns, for a term of twenty-five years for such land, with the proviso and condition inserted therein that the grantee therein shall pay to the Treasurer of the State at the end of every three months a royalty of one dollar per ton for each and every ton of the crude phosphate rock or deposit mined, dug or removed.

1891, c. 476, s. 2.

1753. *Exclusive right to mine; bond for royalty.* Such grantee, his heirs or assigns, shall have the exclusive right to mine, dig or remove any such phosphate rock or deposit for the term of twenty-five years from the date of said patent upon paying the said royalty of one dollar specified in said patent: *Provided, however,* that as a condition precedent to the granting of any such patent each such company or person making any such entry shall enter into bond with sufficient security in the penal sum of five thousand dollars, conditioned for the making of faithful and true returns to the Treasurer of the State of the number of tons of phosphate rock and phosphate deposit so dug, mined or removed, at the end of every month, and the punctual payment to the said Treasurer of the royalty of one dollar per ton upon each and every ton of the crude rock, without being steamed or

dried, at the end of every three months, and the said bond and sureties shall be subject to the approval now required by law for the bonds of State officers.

1891, c. 476, s. 3.

1754. *Navigation not obstructed by grantee.* No grant issued under the provisions of this subchapter shall confer upon the person receiving the same the right to obstruct the navigation of any such stream or water, nor confer upon any such person or his assigns any other right than that granted to take, mine or dig phosphate rock or deposit therefrom.

1891, c. 476, s. 4.

1755. *Fees for issuing grant for phosphate beds.* No fee or cost shall be charged or collected by the Secretary of State of any person or corporation receiving any patent or grant under this subchapter, except the fee allowed by law to the said Secretary of State for issuing a patent under the entry laws of the State.

1891, c. 476, s. 5.

1756. *Failure to operate for two years vacates grant.* Any person, company or corporation who shall fail to dig, mine or remove phosphate rock or deposit from any such stream or water to which he or it may be entitled under any patent or grant issued under the provisions of this subchapter for the period of two years from the date of said patent, or, after beginning digging, mining or removing the same, shall fail to continue to so dig, mine or remove the same for the period of two years, shall forfeit any and all rights therein granted, and said territory shall immediately thereupon become subject to entry under the provisions of this subchapter without making the affidavit of the discovery of any such deposits or rocks.

1891, c. 476, s. 6.

1757. *May be mined without grant, how.* Any person or corporation resident of this State shall have the right to mine, dig or remove phosphate rock or deposits from any of the navigable streams or waters in this State to which no exclusive patent or grant may have been issued, upon such person or corporation first entering into bond in the penal sum of five thousand dollars, payable to the Treasurer of the State, for the payment of the same royalty, in the same manner and under the same regulations as are prescribed in section one thousand seven hundred and fifty-three; but nothing in this section shall be construed to give to any such person or corporation any exclusive franchise or privilege to dig, mine or remove any such phosphate rock or deposit from any stream or water of this State.

1891, c. 476, s. 7.

3744. *Phosphate rock in rivers.* If any person shall dig, mine or remove any phosphate rock or deposit from any of the navigable waters of the State, except for the purpose of prospecting and discovering as allowed by law, he shall be guilty of a misdemeanor, and shall also forfeit and pay ten dollars per ton for every ton of phosphate rock or deposit so mined, dug, or removed, one-half to the use of the State and the other one-half to go to the informer.

## MARL BEDS.

3796. *Marl beds, failure to enclose.* If any person shall open any marl bed without surrounding it with a lawful fence, he shall be guilty of a misdemeanor, and upon conviction shall be fined not exceeding fifty dollars or imprisoned not exceeding thirty days: *Provided*, this shall not apply to any person whose marl bed is enclosed inside his own enclosure.

## PUBLICATIONS

OF THE

## NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY.

### BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *Postage 25 cents. Cloth-bound copy 50 cents extra.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*

8. Water-powers in North Carolina, by George F. Swain, Joseph A. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. Drinking-water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 6 cents.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *Postage 4 cents.*

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *Postage 6 cents.*

13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Postage 4 cents.*

---

VOLUMES.

Vol. 1. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *Postage 32 cents. Cloth-bound copy 50 cents extra.*

Vol. 2. Fish and Fisheries in North Carolina, by H. M. Smith. *In press.*

Vol. 3. Miscellaneous Mineral Resources in North Carolina, by Joseph Hyde Pratt. *In preparation.*

---

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS, OR QUANTITATIVE DETERMINATIONS, WILL BE MADE. Samples should be in a lump form if possible, and marked plainly with name of sender outside of package, post-office address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

---

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

THE NORTH CAROLINA GEOLOGICAL SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST.

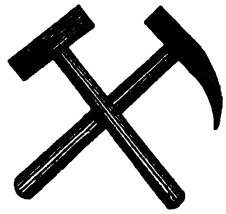


Economic Paper No. 12.

# INVESTIGATIONS RELATIVE TO THE SHAD FISHERIES OF NORTH CAROLINA

BY

JOHN N. COBB.



RALEIGH:
E. M. UZZELL & CO., STATE PRINTERS AND BINDERS.
1906.

THE NORTH CAROLINA GEOLOGICAL SURVEY

JOSEPH HYDE PRATT, STATE GEOLOGIST.

---

**Economic Paper No. 12.**

---

# INVESTIGATIONS RELATIVE TO THE SHAD FISHERIES OF NORTH CAROLINA

BY

JOHN N. COBB.

RALEIGH:
E. M. UZZELL & CO., STATE PRINTERS AND BINDERS.
1906.

# GEOLOGICAL BOARD.

GOVERNOR R. B. GLENN, *ex officio Chairman*..... Raleigh.

HENRY E. FRIES..... Winston-Salem.

FRANK R. HEWITT..... Asheville.

HUGH MACRAE..... Wilmington.

FRANK WOOD..... Edenton.

---

JOSEPH HYDE PRATT, State Geologist..... Chapel Hill.

# LETTER OF TRANSMITTAL.

RALEIGH, N. C., August 1, 1906.

*To His Excellency,* HON. ROBERT B. GLENN,

*Governor of North Carolina.*

SIR:—I herewith have the honor to submit for publication as Economic Paper No. 12 a report on the Investigations Relative to the Shad Fisheries of North Carolina. This report is supplemented by charts and tables which show the condition of this fishery in North Carolina for 1906, location of nets and the yield of fish. This paper has been especially prepared for the use of the committee who are investigating the general condition of all the fishing industries of North Carolina.

Yours obediently,

JOSEPH HYDE PRATT,

*State Geologist.*

# CONTENTS.

# MAPS.

# PREFACE.

At the request of the North Carolina Geological Survey, the United States Bureau of Fisheries, through Hon. George M. Bowers, its Commissioner, detailed Mr. John N. Cobb as special agent to investigate the shad fisheries of North Carolina for the season of 1906. About seven weeks were spent in the field in examining the location of nets, taking account of the run and catch of shad, and making notes on the general fishing conditions in all the sounds and rivers flowing into them.

The condition of the fishing industry in 1906 is compared with previous years, and shows that this particular fishing industry is on a decline in North Carolina, and that unless some steps are taken to remove the causes, it would be but a few years before the shad-fishing industry would be at a very low ebb, if not a thing of the past.

This report is published as an Economic Paper of the North Carolina Geological Survey, with the permission of the United States Bureau of Fisheries, in order that it could be made of more use in connection with the deliberations of the committee recently appointed by the Geological Board to investigate the general condition of all fishing industries throughout eastern North Carolina.

JOSEPH HYDE PRATT,
*State Geologist.*

# INVESTIGATIONS RELATIVE TO THE SHAD FISHERIES OF NORTH CAROLINA.

By JOHN N. COBB.

## INTRODUCTION.

Pursuant to orders dated March 3, 1906, directing me to make certain investigations relative to the shad fisheries of North Carolina for the season of 1906, I left Washington on March 5, and, beginning my work on the Cape Fear River, I worked northward, visiting all the rivers and sounds where shad are caught.

Complete data covering the apparatus used in the fisheries were secured, but as the season was not yet at an end in any part of the State, only general information in regard to the catch of shad was secured covering the period up to the time of my visit.

For some seasons the shad fisheries of the State show a remarkable decrease, as is clearly evidenced by the table given herewith (Table I). In this table the catch of shad in each form of apparatus is shown for each year for which data are available. According to this table the fisheries gradually increased from 1880 to 1897, but from that time on the decline was much more rapid than the increase had been, as by 1904 the catch had dropped to practically what it was in 1880. In the seine fisheries 1896 was the banner year, when 2,131,864 pounds were secured. The decline was very rapid, however, as by 1904 the catch amounted to but 345,046 pounds. The most productive year for gill-nets was 1897, when 4,916,952 pounds were secured, but in 1904 the catch had dropped to 1,147,268 pounds. In 1887 the pound-net catch amounted to 389,921 pounds, but by 1897 it had increased to 2,328,585 pounds. In the face of a remarkable increase in the number of nets set since 1897 the catch decreased from season to season until in 1904, when the quantity secured in pound-nets was 1,647,897 pounds. The catch in minor apparatus reached its maximum in 1896 when 245,268 pounds were secured. By 1904 the yield in this apparatus had decreased to 9,548 pounds.

TABLE I.—*Showing for certain years the catch of Shad in each form of apparatus used in the fisheries of North Carolina.*

| Years. | Seines. | | | Gill-Nets. | | | Pound-Nets. | | | Minor Apparatus. | | | Total. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number. | Pounds. | Value. | Number. | Pounds. | Value. | Number. | Pounds. | Value. | Number. | Pounds. | Value. | Number. | Pounds. | Value. |
| 1880 | | | $ | | | $ | | | $ | | | $ | 920,360 | 3,221,263 | $329,569 |
| 1887 | | 1,619,012 | 98,136 | | 2,562,381 | 166,224 | | 389,921 | 24,429 | | 101,850 | 5,846 | 1,356,064 | 4,746,226 | 298,069 |
| 1888 | | 1,731,863 | 83,763 | | 3,338,352 | 179,945 | | 433,269 | 21,631 | | 127,225 | 7,070 | 1,608,774 | 5,693,429 | 295,029 |
| 1889 | | 1,618,798 | 81,580 | | 3,179,821 | 167,470 | | 385,517 | 21,648 | | 172,250 | 9,500 | 1,530,394 | 5,356,386 | 280,198 |
| 1890 | | 1,844,729 | 98,457 | | 3,348,577 | 175,388 | | 404,359 | 22,513 | | 170,748 | 9,657 | 1,612,594 | 5,768,413 | 306,015 |
| 1896 | 532,966 | 2,131,864 | 90,899 | 1,027,597 | 4,465,746 | 222,990 | 478,531 | 2,009,830 | 90,690 | 57,710 | 245,268 | 12,664 | 2,096,804 | 8,842,708 | 417,243 |
| 1897 | | 1,507,242 | 60,235 | | 4,916,952 | 205,079 | | 2,328,585 | 88,293 | | 210,709 | 9,204 | 2,170,800 | 8,963,488 | 362,811 |
| 1902 | | 996,181 | 59,605 | | 3,660,410 | 218,860 | | 1,701,609 | 93,185 | | 206,524 | 13,158 | 1,641,681 | 6,566,724 | 384,808 |
| 1904 | 87,214 | 345,046 | 30,810 | 285,516 | 1,147,268 | 104,010 | 432,060 | 1,617,897 | 168,449 | 20,865 | 89,548 | 9,681 | 825,555 | 3,229,759 | 312,950 |

Unfortunately, the decrease in the shad fisheries has not been confined to North Carolina alone, as is amply evidenced by the table on page 10, in which is shown for certain years the quantity and value of shad produced in each State on the Atlantic coast in which the shad fisheries are prosecuted. When data for certain States are not presented it indicates that the fisheries of that State were not canvassed by the Bureau for the year in question. According to Table II, all States, with the exception of Florida, Georgia, and Rhode Island (none of which have been canvassed since 1902, since which year the greatest decreases appear to have occurred), show large decreases since 1896, the fisheries of New Jersey alone having dropped from 13,909,826 pounds in 1896 to 4,337,907 pounds in 1904, a decrease of 7,571,919 pounds.

The two preceding tables (III and IV) show by water area the apparatus employed in the shad fisheries of North Carolina for the years 1896, 1904, and 1906; also the catch by each form of apparatus in 1896 and 1904. The most notable feature of the first table is the increasing use of pound-nets in the fisheries. In 1896 there were 1,575; in 1904, 2,837; and in 1906, 3,088. In 1896 there were 57,787 stake and anchored gill-nets employed in the shad fisheries. By 1904 the number had increased to 62,941, but by 1906 it had dropped to 40,089. Seines show a heavy decrease, having dropped from 230 in 1896 to 110 in 1904 and 109 in 1906. These tables have been discussed more in detail under the respective headings of the water areas.

In the following pages the condition of the shad-fishing industry along the various rivers and sounds is taken up under each river and sound, beginning with the Cape Fear River and its tributaries and extending northward.

### CAPE FEAR RIVER AND TRIBUTARIES.

This is the most southern river which is wholly within the State. The main Cape Fear is navigable to Fayetteville, 145 miles from the ocean. This is also about the limit of the commercial fisheries for shad. In showing the data gathered during the season of 1906 the river has been divided into two sections—the Wilmington section, from the mouth of the river to the entrance of Black River, 15 miles above Wilmington, and the upper section, from the Black River to several miles above Fayetteville—for the purpose of comparison with the previous years.

### THE WILMINGTON SECTION.

In this section drift and stake gill-nets are employed exclusively.

The stake-nets are restricted to the east side of the river in New Hanover County, and as they must not approach the western shore nearer than a half mile, and are prohibited above the entrance of Brunswick River, they are practically confined to that section of the river between its mouth and the entrance of the Brunswick River. Although nets have in previous seasons been set as high as a little above the upper end of Campbell Island, in 1906 the uppermost net was located one mile above Doctors Point, while the lowermost net was set off the eastern end of Battery Island, near the mouth of the river. The greater part of the nets are between Federal Point and Doctors Point, where the river is the widest. According to law, the following rules prevail in setting these nets:

"They shall begin at a point 100 yards from the edge of the channel on the east side of said river and, running thence due east 120 yards, then leaving a gap of 120 yards. Then from the east end of said gap another net may be set 120 yards only, and to continue in the same proportion, always requiring a gap of 120 yards to intervene between each 120 yards of nets so set, and no net or sets of nets of any kind shall be placed opposite said gaps, within a distance of a half mile of same, and none of the nets so set shall be nearer than a half a mile of the west shore of said Cape Fear River."

The set-nets operated are about 12 yards long, with 5½-inch stretch mesh, and about 50 meshes deep. The largest number owned by any one man was 75. About two-thirds of the nets are in the water at one time, the others being on shore to be dried, cleaned, and repaired. Considerable complaint is made that the set-netters do not work their nets often enough, and as a result the fish are eaten by eels and crabs or washed out of the nets at the change of the tide. During 1906, 500 set-nets, with a total length of 6,070 yards, and a value of $1,180, were set. This was an increase of 325 over 1904. None were operated in 1896.

**Drift-Nets.**— In this section of the river drift-nets are operated from a short distance above the Quarantine Station to Dollison, 1½ miles below the mouth of Black River. Below Wilmington, where the river is much wider than above, the nets range from 200 to 425 yards in length, have 5½-inch stretch mesh, and are from 40 to 60 meshes deep. Above Wilmington they are about 150 yards long, with 5½-

inch stretch mesh, and are 60 meshes deep. The drift-nets operated in the Brunswick River (this being a thoroughfare about 12 miles in length which leaves the Cape Fear River about 4 miles above Wilmington and re-enters it 4 or 5 miles below that city) average 130 yards in length, with 5½-inch stretch mesh, and are from 30 to 40 meshes deep. During 1906, 110 drift-nets, with a total length of 29,830 yards, and valued at $4,895, were operated in this section, as compared with 90 nets operated in 1904 and 113 in 1896. In the latter year, however, much shorter nets were employed.

According to law, no drift-net longer than 300 yards can be operated in this section of the river; but this appears to be "more honored in the breach than in the observance" in the portion below Wilmington. The same is true of the law forbidding the catching of "any fish in the waters of the Cape Fear River from its mouth to the Bladen County line * * * between six o'clock P. M. on Tuesday and six o'clock P. M. on Wednesday." While I was in Wilmington (in March) the fishermen were much exercised over a rumor that the authorities of Brunswick County were going to enforce the law, but those on the New Hanover County side seemed to have no fear on that score.

One bad feature of the drift gill-netting below Wilmington is that the nets are run too close together and cover too much of the channel.

The total catch of shad in this section of the river, including also the North East River below Three Cypresses, for certain seasons has been as follows: In 1889, about 70,000 fish; in 1890, 60,695; in 1891, 55,976; in 1896, 49,434; and in 1904, 48,487. In the latter year 41,170 shad were taken in drift-nets and 7,317 in set-nets. In 1890, 108 drift-nets were employed; 115 in 1891; 125 in 1896; 90 in 1904, and 115 in 1906. This gives an average per net of 562 shad in 1890; 487 in 1891, 363 in 1896, and 457 in 1904. As the catch of set-nets is available for one season only (1904), no comparisons can be made in regard to it.

Up to the time of my departure from this river (about the middle of March) but few shad had been secured. Most of the dealers and fishermen thought the season up to that time had been better than the season of 1905 during the same period, but all seemed to be agreed that the 1905 season was the worst they had ever experienced. Advices received as late as April 28 are to the effect that the season as a whole has been better than that of 1905.

### NORTH EAST RIVER.

This river, which is about 120 miles in length, rises in the northeast portion of Duplin County and empties into the Cape Fear at Wilmington. It is navigable for small steamers as high up as Hallsville, a distance of 89 miles. A few fishermen from Wilmington and points along the shore operate drift-nets from the mouth to Castle Hayne, a distance of 27 miles; these nets being about 150 yards in length, 5½-inch stretch mesh, and about 60 meshes deep. A few drift-nets are also operated in the vicinity of Rocky Point, about 35 miles from the mouth. The greater part of the fishing, however, is carried on with seines. These are operated from Krooms Bridge, 56 miles from the mouth, to Kornegays Bridge, a distance of 103 miles from the mouth. In 1896 there were operated on this river 12 drift gill-nets and 17 seines; in 1904, 13 drift gill-nets and 12 seines; and in 1906, 13 drift gill-nets and 17 seines. A number of seine-beaches have not been worked for some years now, owing to the scarcity of fish. In 1896 the number of shad taken in gill-nets was 4,062, and in seines, 6,989—a total of 11,051. In 1904 the catch of shad in gill-nets was 2,192, and in seines 4,250—a total of 6,442, or a decrease of 4,609. Up to the time of my visit to this river in March almost no fish had been taken, and what little had been secured were taken by gill-nets, as the river had been quite high for some time and the seines were unable to operate.

The following are the laws at present in force on this river:

"If any person shall fish in the northeast branch of the Cape Fear River with seine, net, or trap, from the twenty-third day of February to the first day of July of any year, between the hours of six o'clock P. M. on Saturday and six o'clock P. M. on Monday of each week, or shall at any time use more than one seine at a time in any fishing-hole in said river, or use, set, or place in said river any hedge, trap, or other obstruction which will prevent the free passage of fish up said river, which said hedge, trap, or other obstruction shall extend more than one-third across the main channel of the said river, he shall be guilty of a misdemeanor. This section shall not apply to that portion of said river which lies between the city of Wilmington and a point on said river known as The Three Cypresses, 12 miles distant from said city of Wilmington."

In that portion of the North East River in Pender County, fishing with nets is prohibited "between six o'clock P. M. on Tuesday and six o'clock P. M. on Wednesday."

The destruction of fish by any means, except with hook and line, is prohibited in that portion of the North East River lying in New Hanover County "between the fifteenth days of May and August of each year."

There does not seem to be any necessity for additional laws covering the fisheries of this river.

## PAMLICO SOUND.

Pamlico Sound is an irregularly shaped body of water running parallel to the coast line for about one-fourth of the length of the State, being separated from the ocean by a long, narrow sand-beach known as "The Banks." This sound is about 75 miles long, measured on a line drawn from the mouth of the Neuse River northeastward, the greatest width about 25 miles and the average width nearly 20 miles, the whole covering about 1,660 square miles. At the north end it communicates with Albemarle Sound through Roanoke and Croatan sounds, while on the south it joins Core Sound. Two large rivers, the Neuse and Pamlico, enter the sound from the west. Communication is had with the sea through Oregon, New, Hatteras, and Ocracoke inlets, each less than half a mile across. The greatest depth of water in the sound is 24 feet, but shoals, especially in the northeastern portion, are numerous. As the river water from about one-half of the State, and a part of Virginia, empties into Pamlico Sound, it counteracts the effect of the natural ebb and flow of the ocean tide, and as a result there are no tides in the sound except such as are produced by heavy winds. During the greater part of the year the waters of the sound are salt or brackish, but during the season of heavy rains the immense volume of water coming down from the rivers makes the water, except in the vicinity of the inlets, quite fresh.

Owing to its extremely favorable location, the shad fisheries of this sound are the most important in the State. By far the greater part of the fisheries are located in the northeastern portion, where the shoals are most numerous, east of a line drawn from Hatteras Inlet to Long Shoal Point, almost all of this area being within the

bounds of Dare County. The fishing is generally carried on from temporary camps scattered along and over the sound, the most important of these being Roanoke Marshes, Hog Island, Duck Island, Sandy Point, Rodmans, Baums Slew, Davis House, and Gull Island in Dare County, and Swan Point in Carteret County. The permanent settlements from which fishing is prosecuted are Stumpy Point, Englehard, Manteo, Rhodanthe, Avon, Buxton, Trent, and Hatteras, in Dare County, and Hobucken in Pamlico County.

Stake-nets and pound-nets were almost the sole apparatus used in the capture of shad in the sound in 1906, but 14 anchored gill-nets having been employed. Stake-nets average 18 yards in length, 6 to 16 feet deep, with 5¼ to 5½-inch stretch mesh, and are set in strings comprising a widely varying number. The greater part are set on the shoals in the eastern part of the sound, north of New Inlet, the Duck Island flats being the favorite spot from about 1894 to 1905, when the Vann law compelled the greater part of the nets set here to be removed. On these flats the depth averages 3 feet and in many places is so shoal that the fishermen can wade alongside the nets very easily, and thus remove the fish. The nets set in the sound are generally allowed to remain in the whole season, as they do not seem to rot or foul as in the fresh water. The season for gill-nets is generally from the first week in February to about the middle of April. The gill-netters of this region have had a number of disastrous seasons of late years, owing largely to the unusual clearness of the water; but up to the middle of March of the 1906 season gill-nets had secured nearly all of the few shad taken up to that time. As remarkably good prices were obtained for these, it is probable that the gill-netters ended the season with a balance on the profit side. During the season of 1906, 19,483 stake and anchored (14 of the latter style) gill-nets, with an aggregate length of 255,442 yards, and a total value of $29,409, were used. In 1904, 40,000, and in 1896, 24,808 of these nets were operated. The drop of 20,517 in two years is partly explained by the operation of a new fishery law, which will be discussed farther on. These nets, in 1896, took 387,236 shad, while in 1904 but 121,616 shad were secured, a decrease of 265,620 fish, at the same time that there was an increase of 15,192 in the number of nets used. This gives an average of almost 16 shad to the net in 1896, and only 3 shad to the net in 1904—a most remarkable falling off.

During the season of 1906 fishing for shad with gill-nets was prosecuted for the first time off Swan Point, in Carteret County, by fishermen from Roe in the same county. Stake gill-nets to the number of 709 and 14 anchored gill-nets were used. The stake-nets were of the regulation kind operated in the sound, while the anchored nets were each about 100 yards in length, 5½-inch stretch mesh, 40 meshes deep, and cost about $15 each. A fairly profitable season was had.

The pound-nets in this region cost about $100 each. The "pound" is generally 10 yards square, the "heart" 45 yards on each side, and the "leader" from 50 to 350 yards long. The mesh in the "pound" is $2^1_4$ inches, in the "heart" 3 inches, and in the "leader" 4 inches. A number of fishermen, however, operate what are known as "shad-pounds," the only difference being in the wider mesh of the different parts, in order that herring and other small fish may pass through. They are generally set from the shore in strings of from 1 to 10, but during the last few seasons a number have been set along the outer line of shoals in the northeastern part of the sound. The pound-nets in this sound have been steadily increasing in number for some years. In 1896, 171 were in use; in 1904, 474, while in 1906 the number had increased to 678—a gain of 507 in ten years. The catch of shad in pound-nets in 1896 was 60,853 in number, while in 1904 it amounted to 225,677 fish—a gain of 164,824. In 1896 the average catch of shad per net was 355, while in 1904 it was 476, thus showing a real gain. The season of 1906 was an exceptionally poor one for the pound-netters, owing to the muddy water, the fishermen claiming that shad will not enter the nets in any number unless they are able to see the leader distinctly.

The Legislature in 1905 passed the following law, commonly known as the Vann law, the greater part of which applies exclusively to Pamlico Sound:

**Dutch-Nets in Pamlico and Albemarle Sounds.**—If any person shall set or fish any net, seine, or appliance of any kind for catching fish at any place within a radius of two and one-half miles either way from Roanoke Marshes light-house at a distance more than five hundred yards from the shore of Roanoke Island or the mainland on the western side of Croatan and Pamlico sounds; or shall set or fish any pound or dutch-net on the eastern side of Pamlico Sound within ten miles of the Roanoke Marshes light-house, except such as shall be fished within five hundred yards of the Roanoke Island or Hog Island shores; or shall set or fish any dutch or pound-net on the eastern side of Pamlico Sound more than two thousand yards west of a

line running south-southeast from Big Island to Bulkhead or shoal west of Chicamacomico or south of said point more than two thousand yards from the shoals as marked on the United States Government chart, made from data obtained to November twenty-second, one thousand nine hundred and four, or shall set or fish any dutch or pound-net on the west side of Pamlico Sound in said sound extending into the water more than two thousand yards from the shore of the mainland; or shall set or fish any pound or dutch-net in Croatan Sound further from the shore than one-fifth the width of said sound at that point; or shall set or fish any pound or dutch-net in the Albemarle Sound more than two thousand yards from the shore of the mainland, or in Chowan River further from shore than one-third the width of said river at place where said nets are fished or set, or within one-fourth mile of any wharf used by a steamer on said river; or shall set or fish any net or appliance of any kind for catching fish within one mile on north or south side of a line five miles long running west from center of New Inlet or Oregon Inlet, or on north or south side of a line five miles long running northwest from center of Hatteras Inlet, he shall be guilty of a misdemeanor and be fined or imprisoned in the discretion of the Court. The provisions of this section shall apply only to that part of each year beginning January fifteenth and ending May fifteenth. The place of trial for offenses under this section shall be the county opposite where the act was committed. It shall be the duty of the Oyster Commissioner or Assistant Oyster Commissioner, whenever an affidavit is delivered to him stating that the affiant is informed and believes that this section is being violated at any particular place, to go himself or send a deputy to such place, investigate same, and he shall seize and remove all nets or other appliances setting or being used in violation of this section, sell same at public auction and apply proceeds of sale to payment of cost and expenses of such removal, and pay any balance remaining to the school fund of county nearest where offense is committed.

This law, owing to its radical provisions and its far-reaching effect upon a population devoted almost exclusively to fishing, has met with considerable opposition as regards certain provisions, in Dare County, to which it mainly applies.

The provision forbidding the setting of nets "within one mile on the north or south side of a line 5 miles long running west from center of New Inlet or Oregon Inlet, or on north or south side of a line 5 miles long running northwest from center of Hatteras Inlet" meets with almost unanimous approval. Part of this unanimity may be due, however, to the fact that at both Oregon and New Inlets the channels, a mile or two inside of the inlets, swing to the southeast and leave the closed area, and gill-nets set along them prove quite profitable, while at Hatteras Inlet the channel leaves the closed area about 1½ miles inside of the inlet, and as there is a shoal just east of the line, the fish are forced out towards Hatteras Inlet light where

the pound-nets are located. With the exception of Hatteras Inlet, no pound-nets have, in recent years, been located in this restricted area, but large numbers of gill-nets were set in the vicinity of New and Oregon Inlets, and these have all had to be removed outside the line. As gill-net fishing had been unprofitable for several seasons, a number of the dispossessed fishermen abandoned this form of fishing altogether this season.

Other provisions which meet with general approval are those forbidding the setting of nets in Pamlico Sound off the Roanoke Island or Hog Island shores, or more than 2,000 yards from the mainland shore on the western side of the sound. A glance at the two charts (for 1904 and 1906) showing the nets set in the first-named area will show the absolute necessity of the law in question. In 1904 the mouth of Croatan Sound was almost entirely blocked by the strings of pound-nets set off the Marshes shore, around Buntings and Big Islands, and in Pamlico Sound a few miles off the Hog Island shore. As nearly all of the shad going north pass through Croatan Sound, this arrangement of nets virtually cut off the fish from the fishermen of Croatan and Albemarle sounds and the tributaries of the latter. Under the present law this passage is left entirely free, and it should be the first aim of the State to keep it so.

I found some objection to the provision forbidding the setting of nets "within a radius of two and one-half miles either way from Roanoke Marshes light-house at a distance more than 500 yards from the shore of Roanoke Island or the mainland on the western side of Croatan and Pamlico sounds." Under this provision those fishermen who had been setting their nets in the bays just south and north of the Marshes, within the restricted area, found themselves cut off by the long strings set just without the bounds. As the general desire was to prevent the setting of long strings in the narrow section where Pamlico and Croatan Sounds meet, no harm could result if the strings north and south of the Marshes were allowed to extend out in an easterly direction to the outer edge of the Marshes.

The chief objection I found to the law was as to the provision forbidding the setting of "any pound or dutch-net on the eastern side of Pamlico Sound within ten miles of the Roanoke Marshes light-house, * * * or shall set or fish any dutch or pound-net on the eastern side of Pamlico Sound more than 2,000 yards west of a line running south-southeast from Big Island to Bulkhead or shoal

west of Chicamacomico or south of said point more than 2,000 yards from the shoals as marked on the United States Government chart made from data obtained to November twenty-second, one thousand nine hundred and four." The principal point urged against this law was that it forced the fishermen so far down in the sound that they were compelled to employ power boats to go and return, while their employees had to work longer hours, and as a result many refused to work on these strings and sought employment with those better situated. As only a few nets can be set in the restricted area around the South end of Roanoke Island and Hog Island, and as the unrestricted areas in the vicinity were already occupied, some of the pound-netters have had to go as far south as Gull Island on the eastern side and to Middletown, in Hyde County, on the western shore. It is really questionable whether it is necessary for the preservation of the fisheries to block off such a large area. It should be stated, however, that a few fishermen (but none in the area affected) feel that this provision of the law is a necessary one. Should this area be thrown open again it might be well to hold the strings down to the 2,000-yard length, and also require that each string be set in practically a straight east and west line, with the hearts all opening in one direction. This would do away with the triangles and hooks now so popular, and give the shad a better chance for their lives.

Although stakes had been put in showing the restricted area to ten miles from the light, I found a number of strings set almost up to the 2½-mile area from the Roanoke Marshes light. A few fishermen lived strictly up to the law, very much to their financial loss. In the other restricted areas I found the law very generally obeyed.

The pound-netters south of Chicamacomico complain bitterly because of the law restricting them to 2,000 yards from the shoals. From Hatteras Inlet the "Banks" run in an almost due east course to Cape Hatteras, and from there they take a north and easterly course. The widest part of the sound is from the inside of Cape Hatteras to Long Shoal Point on the western shore, nearly 25 miles, and as the shoals on the eastern side do not extend out more than 6 or 7 miles, this leaves an area nearly 20 miles wide in which pound-nets cannot be set. The angle of the "Banks" makes a bight in this section in which shad are found in but slight numbers, as the fish from Hatteras Inlet go up the Sound some miles to the westward. But little, if any, damage would be done by remov-

ing all restrictions on the eastern side below Gull Island (except around Hatteras Inlet), as but few fishermen would set nets out near the middle of the sound, owing to the distance from camps and the danger of damage to their nets during the usually stormy spring months when fishing is carried on.

A few of the pound-net fishermen suggested to me that it would be much better for the shad fisheries if the pound-nets set in Pamlico and Croatan sounds were all of what is known as "shad-pound" mesh. This would allow the alewives and small fish to escape, and as the pound-netters in this region are after shad principally, not having the labor available to handle alewives profitably, it would allow all of the latter and also all other small fish to escape. If this were done in the fall it would allow the young shad to escape, and thus prevent the destruction now going on in the latter species during the fall fishing.

Some fishermen claim that shad frequently spawn in Pamlico Sound. While this might occur under unusual conditions, such as extreme freshness of the waters of the sound or long-continued cold winds from the northwest, it would be an exceptional occurrence under ordinary conditions, as is shown by the large numbers which go up into Albemarle Sound, the favorite spawning ground of the shad; also by the fact that the pound-netters report the catch of but few shad in a ripe condition.

An impression exists among some of the fishermen that shad winter in the sounds, and in confirmation of this they point to the fact that shad are very rarely seen going through the inlets, which would be an easy matter to observe in daylight, owing to the clearness of the water in these narrow places, and also that shad taken in gill-nets near the inlets are generally found with their heads pointing towards the ocean, thus showing that they had gilled on the far side of the net. This contention is not borne out, however, by the experience of those pound-netters who set their nets in the sound during the fall months. While quite young shad are frequently taken in these, it is rare to find a mature one in them. It is also probable that shad are not observed coming through the inlets, as at that time they have not yet begun to school, and it is also probable that many come through at night.

## NEUSE RIVER AND TRIBUTARIES.

The Neuse River is formed in Durham County, N. C., by the junction of the Eno, Flat, and Little rivers, and from that point to New Bern is a distance, following the windings of the stream, of 260 miles. In the 40 miles of river below New Bern it widens very much and becomes virtually a broad arm of Pamlico Sound. Its principal tributaries are the Trent, Contentnea, and Little rivers. Formerly, shad ascended this river to its uppermost limits, and extensive fisheries are said to have existed near Raleigh, 190 miles from New Bern. At present, however, commercial fishing does not extend above Goldsboro, although considerable fishing for home use is prosecuted above that city. For purpose of comparison with the canvass of 1896 the shad fisheries of this river are divided into two geographical sections, viz.: (1) the lower, 72 miles from Pamlico Sound to Contentnea River, and (2) from Contentnea River to the headwaters.

### FROM THE MOUTH TO CONTENTNEA RIVER.

From New Bern to the mouth, the river ranges in width from 6 to 1½ miles, and from New Bern to the Contentnea it is from 250 to 80 feet wide at low water. The forms of apparatus used in this section of the river are seines, drift and stake gill-nets, pound-nets, and bow-nets. All but a few of the seines are operated at regular beaches, the others being hauled at places where it seemed fishing would be most successful. In 1896 there were 5 seines operated for shad on the river between New Bern and the mouth; in 1906 there was but 1 used. This seine was 1,000 yards in length, 14 feet deep, with stretch-mesh of 2½ inches in the bunt, and from 2¾ to 3 inches in the balance. It was hauled by 6 men and 2 mules. The seine at Johnsons Point was operated at a loss in 1905 and then abandoned. Between New Bern and Cowpen Landing 9 seine-beaches (1 on Bachelors Creek), with 11 seines, were operated in 1906. At two of the beaches 2 seines each were operated in the busy season. The seines in this reach range from 150 to 300 yards in length. In the whole section from the mouth to Contentnea River there were 17 seines operated in 1906 as compared with 13 in 1904 and 86 in 1896. The catch of shad in these seines amounted to 105,210 in 1896 and 5,672 in 1904, a decrease of 99,538 fish.

The stake gill-nets used in the Neuse River are set in strings of about 20 each. They are each about 20 yards long, 5¼-inch stretch mesh, 30 to 40 meshes deep, and cost about $1. The favorite spots for stake-nets are just below the road bridge at New Bern, some of the nets being tied at one end to the piling of the bridge, between Upper Broad Creek and Goose Creek, off the mouth of Slocums Creek, and close to Cherry Point. In 1906, 3,232 of these nets were set; in 1904, 3,600; and in 1896, 3,240. In 1896 the number of shad secured in these nets was 23,118, and in 1904, 18,514, a decrease of 4,604. Usually these nets are operated until the early part of April, but at the time of my visit to the Neuse (about the middle of March) nearly all that had been set in the lower reaches of the river had been taken out, owing largely to the small catch up to that time and to the ravages of crabs. This form of apparatus was interdicted by law for many years.

Drift gill-nets are operated generally between Bachelor Creek, 4 miles above New Bern, and Thoroughfare, 9½ miles from New Bern. These nets averaged about 110 yards in length, with stretch mesh of 5¼ inches. In 1906, 20 drift-nets were used; in 1904, 10; and in 1896, 38. The number of shad taken in this form of apparatus in 1896 was 18,485, while in 1904 but 800 were secured, a decrease of 17,685.

The pound-net was first introduced in the Neuse River about 1878. In 1880, 6 were reported, and by 1896 this number had increased to 86, set on both sides of the river. In 1904 there were 77 in use, all located on the north side of the river in Pamlico County, a law forbidding their use elsewhere on the river. The "leads" to these nets average about 200 yards in length, and the mesh in the traps is from 2 to 1½ inches. They are usually put in the water in August or September and allowed to remain in until May. The number of shad taken in this form of apparatus in 1896 was 22,471, and in 1904 it amounted to but 7,392, a decrease of 15,079. There was also a decrease of 10 in the number of nets employed.

Only 15 bow-nets were used in this section in 1906 as compared with 26 in 1904 and 185 in 1896. The catch of shad in this form of apparatus in 1896 was 12,250, while in 1904 the number taken amounted to but 1,360, a decrease of 10,890.

The season of 1906 was somewhat better than that of 1905, but even then shad were quite scarce as compared with the earlier seasons. This year what fish did come up the river appeared late in the season. Alewives were also more plentiful than in 1905, which was a very bad season.

### FROM CONTENTNEA RIVER TO GOLDSBORO.

In this stretch of river during 1906, 8 seines and 117 bow-nets were employed in the shad fisheries, as compared with 12 stake gill-nets, 7 seines, and 170 bow-nets in 1904; and 6 stake gill-nets, 12 seines, and 257 bow-nets in 1896. In the last-named year the canvass was extended to the headwaters, which explains the large number of bow-nets for that year. Seines were operated in 1906 as far up the river as Bear Creek, 69 miles from New Bern. The catch of shad in this stretch of river in 1896 was as follows: In stake-nets, 824; in seines, 6,108, and bow-nets, 11,067. In 1904 the catch of shad by apparatus was as follows: In stake-nets, 206; in seines, 996; in bow-nets, 3,324. All show a decrease for 1904 as compared with 1896.

### CONTENTNEA RIVER.

This river enters the Neuse about 32 miles above New Bern, is 140 miles long, and is navigable as far as Stantonsburg, 63 miles above the mouth. The apparatus used in taking shad in this river consists of seines, stake gill-nets, and wheels. The seines run from 30 to 85 yards in length, with mesh from 2 to 3½ inches. The stake-nets average about 10 yards in length, with mesh of 5½ inches, and are set between Gaskins and McCarters landings. There were also 8 wheels in operation a few miles above and below Stantonsburg. In this latter fishery rows of saplings sunk in the stream and banked with brush are run out from both banks until they are within about 5 feet of each other. In this narrow opening the wheel is placed. This comprises two broad frameworks, like paddles, to which net-bags are attached, the whole looking like two dip-nets attached to an axle. By means of a rude sort of windlass attached to the axle, the paddles are turned by hand, and as the current aids very materially when one of the paddles is in the water, it requires very little strength to operate. When not in use the axle is turned until both paddles are out of the water and then clamped in this position. This brings them so far above the surface that a rowboat can

pass under the paddles through the opening. As an appropriation has been secured for the improvement of the Contentnea, and these wheels were an obstruction to navigation, the United States engineer in charge of the work ordered their removal. They should be prohibited by law also.

In 1896 there were 178 stake gill-nets, 10 seines, and 70 bow-nets operated for shad; in 1904, 100 stake gill-nets, 7 seines, and 44 bow-nets, and in 1906, 48 stake gill-nets, 4 seines, and 8 wheels so operated. In 1896 the catch of shad by apparatus was as follows: In stake gill-nets, 2,541; in seines, 2,573, and in bow-nets, 1,919. In 1904 the catch of shad was as follows: In stake gill-nets, 910; in seines, 1,510, and in bow-nets, 771.

### LITTLE RIVER.

About 2 miles above Goldsboro the Neuse receives the waters of Little River, which is nearly 100 miles long. No effort was made to cover this stream more than a few miles from its mouth, where some fishing was carried on by Goldsboro parties. Three stake gill-nets, 30 yards long, were set about 2½ miles from its mouth.

### RECOMMENDATIONS AS TO THE NEUSE RIVER AND TRIBUTARIES.

The use of two seines at the same time in one fishing-hole should be prohibited. The use of wheels should be prohibited. It seems to me that far too many stake gill-nets are set in the immediate vicinity of the road bridge at New Bern.

## PAMLICO-TAR RIVER.

Pamlico River is only the estuary of the Tar River, the name changing just above the town of Washington. The Pamlico River portion has a length of 37 miles, with a maximum width of 4 miles and a minimum width of about 1-3 of a mile at Washington. The Tar River is 180 miles long, thus giving a total length for both portions of 217 miles. Tarboro, 49 miles above Washington, is the present head of navigation. Shad ascend as far as Rocky Mount, where a natural fall obstructs their farther advance.

By far the greater part of the fishing is prosecuted in the Pamlico River section, and drift and stake gill-nets, pound-nets, and seines are the forms of apparatus employed.

The 12 drift gill-nets used in 1906 averaged 100 yards in length and were operated in front of Washington.

The stake gill-nets are about 20 yards in length, 10 to 12 feet deep, with 5⅜ to 5½-inch mesh, and about 20 are set in a string. They are scattered all along the river from Redmans Point to opposite Sinclairs Creek; Blount Bay and the vicinity of Mauls Point are the favorite spots for setting these nets. In 1896, 840 of these nets were used and took 8,114 shad. In 1904, 1,315 were employed, and took 6,576 shad. In 1906, 1,500 nets were set. This shows a constant increase in the number of nets, but a steady decrease in the catch. Sand-fleas were especially destructive to the nets during 1906, many of the nets being destroyed by them, and at the time of my visit (shortly after the middle of March) only a few strings were in the water.

Seines in the Pamlico River are operated from Mauls Point to the town of Washington. In 1906, 12 were operated in this section, 7 being on the south side of the river, 3 on the north side, and 2 being hauled to islands in the river. These seines range from 350 to 800 yards in length, with meshes from 2 to 2½ inches. The season usually begins early in February below Washington, and about 2 weeks later in the upper portions of the river. In 1896, 23 seines were used on the Pamlico and took 32,178 shad; while in 1904, 16 seines were employed and took 9,840 shad, showing a decrease of 7 seines and 22,338 shad. In 1906, 12 seines were operated.

In 1896, 27 pound-nets were set near the mouth of the Pungo River. An interdiction existed against the use of this form of apparatus at that time, but it was "more honored in the breach than in the observance." In 1903 the Legislature authorized their use in the Pamlico River "below a line beginning on the southern shore of Pamlico River at Mauls Point, and running due north to a point on the northern shore of said river: *Provided*, that no dutch, pod, pyke, or pound-net, or other net of like kind, shall extend out in said river more than one-eighth of the distance across said river from the shore, and that none of said dutch, pod, pyke, or pound-nets shall be set, placed down, or fished nearer to each other than five hundred yards, measuring up and down the river; nor shall they be placed, set down, or fished within five hundred yards of any seine-beach in actual use for hauling a seine, nor within one mile of the mouth of Bath Creek: *Provided*, no nets of the kind enumerated in this

section, or other nets of like kind, shall be placed down, set, or fished in said rivers between the tenth day of May and the first day of July in any year." As there has been considerable objection to the use of pound-nets in this river, I made an especially careful examination of those set during the season of 1906, and am forced to confess that they seem to be less of an obstruction to the ascent of the shad than on any other river and sound where their use is authorized by law. No string has more than 4 nets upon it, while the majority have but 2 and 3, and the law about not running them out more than ⅛ of the width of the river seems to be rigidly obeyed. The section forbidding the setting of these nets within 1 mile of the mouth of Bath Creek is not observed, however. During 1906, 165 pound-nets were set in the Pamlico River, but up to the time of my visit they, as well as the gill-netters, had caught very few shad. In 1904 there were 190 pound-nets set and these took 19,075 shad, a very small catch for such a large number of nets.

### TAR RIVER.

From Washington to Greenville, a distance of 22 miles, 9 seine-beaches were operated in 1906. As the season had been so poor up to the time of my visit, one or two were in doubt about operating, but as they had made ready they have been included. The above is a decrease of 2 as compared with 1904, and of 1 as compared with 1896. These nets range in length from 100 to 400 yards. In 1896 the 10 seines secured 6,515 shad, while in 1904 the 11 seines secured 9,840, a gain of 3,325. Judging from the limited data obtainable the seines operated on the Tar River have held their own better than on any other river in the State.

Bow-nets are operated at favorable points above Washington. In 1896, 98 were operated; in 1904, 174; and in 1906, 60. The number of shad secured in these in 1896 was 6,285, and in 1904 was 3,620.

### PUNGO RIVER.

The Pungo River is a short and broad tributary of Pamlico River. In 1896 there were set 24 pound-nets near the mouth of the river, a decrease of 10 as compared with 1904, when 34 were set. These nets are similar to those operated in the Pamlico River.

## CROATAN SOUND.

This sound, which forms the principal means of communication between Pamlico and Albemarle sounds, is 10 miles long, 2½ to 4 miles wide, and averages 8 to 10 feet deep, the bottom being very uneven. Roanoke Island forms its eastern shore and the mainland the western. Nearly all of the shad passing north from Pamlico Sound traverse Croatan Sound.

The pound-net is the only apparatus of importance set for shad. The western shore is lined with strings of nets, reaching out 1-5 the width of the sound, while but few are operated on the eastern shore. These are operated by people from Callahans Creek, Manns Harbor, and Peter Mashoes Creek on the mainland, and from Skyco on Roanoke Island. The nets are similar to those operated in the northeastern end of Pamlico Sound. In 1896 there were 140 pound-nets operated in this sound; in 1904, 200; and in 1906, 190. The number of shad taken in these pound-nets in 1896 was 73,834, and in 1904, 72,860. The average number of shad per net in 1896 was 527, and 1904, 364, thus showing a very material decrease per net.

In 1906, 1,478 stake gill-nets, of the same length and style as those operated in Pamlico Sound, were set in Croatan Sound. The number of these set shows a steady decrease, as in 1896, 5,625 were set, and in 1904, 2,550. The former gill-netters are now most of them pound-netters. In 1896 the catch of shad in gill-nets numbered 68,626; while in 1904 the number had decreased to 4,898. The catch per net in 1896 was 13, while in 1904 it had decreased to slightly under 2 to the net.

## ROANOKE SOUND.

Roanoke Sound runs parallel to Croatan Sound and is separated from the latter by Roanoke Island. It is about 10 miles in length, from 1 to 2 miles wide, and very shoal except in a narrow channel skirting the shore of the island. But few shad pass through Roanoke Sound, the favorite passage being Croatan Sound.

Only 270 stake gill-nets were set in this sound in 1906 and nearly all off the extreme northern end of the island. There were 46 pound-nets operated in the sound in 1906 and all but 2 of these were between Ballast Point and N. W. Point of Roanoke Island. In 1896, 225 stake gill-nets were operated; in 1904, 1,950, and in 1906, 270. The number of shad taken in these nets in 1896 was

5,000, and in 1904 the number was 1,560; the average per net in 1896 being 22, while in 1904 it was less than 1 to the net. In 1896, 3 pound-nets were set, and in 1904, 43. The catch of shad per net in 1896 was 694, but in 1904 it had dropped to 63 to the net.

## ALBEMARLE SOUND AND TRIBUTARIES.

The magnificent sheet of water known as Albemarle Sound stretches east and west from the coast to a distance of nearly 60 miles, and is said to be the largest coastal body of fresh water in the world. In width it averages 7 or 8 miles and has an area approximating 450 square miles. The only tides on this sound are those caused by the winds, and these are of infrequent occurrence, while it is wholly free from strong currents. Its depth is quite uniform, averaging from 16 to 20 feet.

Stake and anchored gill-nets, seines and pound-nets are the forms of apparatus operated for shad. The principal fishing centers on the sound are Powells Point, Peter Mashoes Creek, Holloways Pier, Pear Tree Point, Leonards Point, Mackeys Ferry, and Edenton. Edenton, Hertford, and Elizabeth City are the principal shipping points.

The anchored gill-nets in 1906 numbered 299, with a total length of 39,150 yards, and a value of $3,937. The greater part of these nets are set in the sound west of the Perquimans River. The only difference between these nets and stake gill-nets is that the former are anchored at each end instead of being secured by stakes, as is the case with the latter. The catch of these nets has been combined with the stake gill-net catch.

The stake-nets operated in this sound are of the same length and style as those described for Pamlico Sound. These nets are set principally on the south side of the sound between Laurel Point and the Alligator River, and on the north side east of Little River. The eastern end of the sound is also a favorite spot. In 1896, 21,985 of these nets (including anchored nets also) were set in the sound and they caught 429,599 shad, an average of 19½ fish to the net, while in 1904, 12,909 nets were operated and caught 61,954 shad, or an average of about 4½ fish to the net. In 1906 there were 13,215 (299 of which were anchored nets) in use, and owing to the muddy water they did fairly well. In 1896 the stake-net fishery was the

most important, but in 1904 the pound-net fishery had achieved the pre-eminence.

The pound-nets in Albemarle Sound are almost essentially the same as those in Croatan and Pamlico sounds. While quite a few are set between Peter Mashoes Creek and Durants Island, on the south side, and at Powells Point, at the eastern end, the great body of them are located in the western half, west of Little River on the north and the Scuppernong River on the south. Some of the longest strings in the State are located in this section. These nets were first introduced in Albemarle Sound in 1870. In 1880 there were 117 in use, in 1896 the number had increased to 612, in 1904 they numbered 714, and in 1906 there was a slight decrease, only 661 being set. The catch in 1880 was 920,360 shad, an average of 7,866 to the net; in 1896 the catch amounted to 173,380 shad, an average of 283 to the net; and in 1904, 69,848 shad were taken, an average of 98 to the net. The pound-nets did very poorly in 1906.

Until about 1860 haul-seines were the only form of apparatus used for shad, and for some years later they were the principal apparatus. Owing to the expense of operating them as compared with gill-nets and pound-nets, they gradually dropped off until in 1906 there were but 3 in operation on the sound—at Drummonds Point and Greenfield in Chowan County, and at Avoca in Bertie County. These seines are among the largest in the country, averaging 2,500 yards each in length. The meshes in the wings range from 2½ to 4-inch stretch, and in the bunt 2-inch stretch mesh. The laying out of the seine is done by means of steam flats. In 1896 there were 4 seines operated on the sound and these secured 132,213 shad, or an average of 33,053 to the net. In 1904, 3 were operated and secured 47,084 shad, or an average of 15,694 shad to the net—less than ½ of the average of 1896.

### NORTH RIVER.

This is a short but comparatively wide river emptying into the eastern part of Albemarle Sound. In 1904, 14 pound-nets were operated in this river, and in 1906, 13. The catch of shad in 1904 was only 700, this river being frequented but little by this species.

### PASQUOTANK RIVER.

This is really an arm of Albemarle Sound, extending 15 miles inland, with an average width of 2 miles and a depth of 10 or 12 feet. In 1896 there were 100 stake gill-nets, 17 pound-nets, 4 seines and 10 minor nets operated for shad; in 1904 there were 100 stake gill-nets and 44 pound-nets set, and in 1906, 47 pound-nets. In 1896 the catch of shad in stake-nets was 1,000; in pound-nets, 2,840; in seines, 4,642, and in minor nets, 275. In 1904 the catch in stake-nets was 130 shad and in pound-nets, 1,100. The run of shad in this river is slight and most of the above apparatus is set for alewives and other species, rather than for shad.

### LITTLE RIVER.

This is quite a short stream emptying into the sound between the Pasquotank and Perquimans rivers. Shad go up it in limited numbers and the pound-nets set in it in 1906 were principally for other species. In 1904, 40 stake-nets, 26 pound-nets, and 1 seine took shad, while in 1906 there were but 22 pound-nets set during the shad seasons.

### PERQUIMANS RIVER.

This is also an arm of Albemarle Sound, 12 miles long, and averaging over a mile in width. Next to the Chowan River this is the most important stream on the north side of the sound up which the shad ascend. In 1896, 765 stake-nets, 71 pound-nets, and 2 seines, caught some shad, the number taken in the stake-nets being 12,428, in the pound-nets 12,718, and in the seines 7,680, a total of 32,822. In 1904, 210 stake-nets took 1,750 shad and 136 pound-nets caught 10,500 shad, a total of 12,250, or a decrease of 20,572.

### YEOPIM RIVER AND CREEK.

In 1904, 52 pound-nets set in the river caught 4,000 shad. In 1906 there were 46 pound-nets set in the river and 5 in the creek. Shad forms but a small part of the total catch of these nets.

### CHOWAN RIVER.

The Chowan is formed by the junction of the Blackwater and Nottoway rivers nearly on the line between North Carolina and

Virginia. From the junction to its mouth is a distance of about 55 miles. For the lower 20 miles the river averages about 1¾ miles in width, and the water is dark and clear. For a few miles above Coleraine the greater part of the river is filled with stumps, while above Hollidays Island the river narrows very much. This river is most noted for its alewife fisheries, the shad catch being very small when one considers the quantity of apparatus used.

Seines, drift and stake gill-nets, and pound-nets are the only forms of apparatus used.

There were formerly a large number of seines on the river, but the unprofitableness of seine fishing, and the lesser cost of operating pound-nets, has led to the abandonment of many of them. In 1896 8 seines were operated and secured 60,450 shad, while 4 were operated in 1904 and secured but 3,885 shad, an average of 7,556 per net in 1896, and of 971 per net in 1904. In 1906 but 3 seines were operated, and all of these were above Hollidays Island.

The Chowan River has the largest number of pound-nets in use of any river in the country, the number in 1906 being 872. In 1896 there were 447 in operation, and in 1904, 833. There is a regular network of nets from the mouth to Tunis, occupying about 2-3 of the river. From Whites Landing to Hollys Wharf a large number are set in the middle of the river in addition to those running out from both shores. The law permits the pound-netters to run their strings out to 1-3 the width of the river. One string of 9 nets at Willow Branch came prominently to my notice, owing to the complaints of some of the fishermen that it extended out almost to the center of the river, and my eye observation bore out their complaint. In 1896 the 447 pound-nets caught 122,595 shad, an average of about 274 to the net; in 1904 the 833 nets secured 13,869 shad, an average of about 17 to the net.

A few stake gill-nets, similar to those in the sound, are set near the mouth. There were 60 of these in 1904 and 120 in 1906.

In the vicinity of the railroad bridge at Tunis 74 drift gill-nets were drifted in 1896, 99 in 1904, and 102 in 106. They averaged 18 yards in length.

### ROANOKE RIVER.

The Roanoke River is the principal tributary of Albemarle Sound, and is a narrow stream, with very rapid current. It rises in Virginia and from the confluence of the Dan and Staunton in Virginia is 198

miles to its mouth. The water of the Roanoke is very muddy and can be traced for many miles after emptying into the sound, by its dingy yellow color.

The commercial shad fisheries are confined quite largely to that portion of the river from the mouth to Williamston. The forms of apparatus employed are seines, bow-nets, drift gill-nets, and wheels.

The seines catch slightly more than ½ of the shad obtained, although they formerly secured over 80 per cent. Seines are operated at Jamesville and from 2 miles above Plymouth to the mouth. The waters of the Roanoke debouch into the sound through three mouths—the Roanoke proper, Middle River and Cashi River combined, and the Eastmost River. Below Plymouth 2 of the fisheries are on the Roanoke, 1 on the Middle River, and 2 on the Cashi River. In 1896, 8 seines were operated and secured 60,450 shad, an average of 7,556 to the net; while in 1904, 8 seines secured 8,200 shad, an average of 1,025 to the net. In 1906, 9 seines were operated. The presence of so many nets near the mouth of such a narrow stream as the Roanoke would appear on the surface as excessive, but nature has put such limits upon their operations as amply protect the stream itself. Freshets are quite frequent on the river, and when these occur it is impossible to operate the seines, thus permitting the shad an unobstructed passage up the river.

A few gill-nets, 18 in 1896, 7 in 1904, and 8 in 1906, are drifted in the vicinity of Plymouth, but the fishery is very insignificant now, 4,000 shad having been secured in 1896 and but 220 in 1904.

A number of wheels are operated close to shore on both sides of the river, but as they only extend out about 12 feet they do no damage to the shad fisheries. A number of bow-nets are also fished at various places along the river as far up as Weldon. In 1896 there were 510 wheels and bow-nets operated and these caught 15,500 shad. In 1904, 126 were operated and caught 6,390 shad. In 1906, 114 were operated.

### SCUPPERNONG AND ALLIGATOR RIVERS.

On the south side of the sound are the Scuppernong and Alligator rivers, in which are carried on extensive pound-net fisheries for alewives, but the number of shad which enter these rivers is exceedingly small, so these nets have not been included in the tables.

The shad fisheries of Albemarle Sound and its tributaries are in a very bad way at present. If this were a temporary condition, due to local adverse conditions prevailing for one, or possibly, two seasons, it might be hoped that matters would soon adjust themselves, and the fish return in as great numbers as formerly; but all information available points steadily in one direction, viz., the shad are not caught in anything like such abundance as say, from five to ten years back, simply because they are not in North Carolina waters to be caught. The fishermen of the sound are thoroughly awake to this fact, and are seeking a remedy. Unfortunately, they have cast their eyes away from home, as is but human, and have failed to notice, or blinded themselves to the conditions prevailing in their own vicinity. For a time the great cry was to "clear the inlets!" The inlets were thoroughly clear last season, and there was but little to prevent the shad from ascending if they so desired, and what was the result? A season as bad, if not worse, than the preceding ones. It is useless to contend that the fishermen in Dare County are solely to blame for the present depleted condition of the fisheries; the blame lies almost as much upon the fishermen of western Albemarle Sound and its tributaries. During the season of 1906 the fishermen of Albemarle Sound and its tributaries operated 1,813 pound-nets, more than were operated in the whole of Virginia in 1904. The greater part of this large number of pound-nets is massed in the western end of the sound and in the Chowan River, on the principal spawning beds. Far be it from me to recommend the abolishment of the pound-net, which can ill be spared in this age of advancement; but something must be done to reduce the enormous number now being set in the sound and its tributaries if it is ever hoped to build up the shad fisheries again. Not content with running out the numerous strings of pound-nets in the narrow portion of western Albemarle, many of the owners also set out long strings of anchored gill-nets in the portions of the sound where pound-nets are not permitted. It would possibly be well to abolish the anchored gill-net altogether in this sound. Such a prohibition would fall but lightly on the fishermen, as nearly all of the owners of such nets are also pound-netters. The conditions in the eastern section of the sound are not so bad as in the western, as but few nets are set in this section, and it is also much wider than the other.

The alewife fishery, which is very important on this sound and its tributaries, is also in bad shape, the decrease in this species being as marked as in that of the shad. As the greater part of these are taken in pound-nets and seines, with the shad, anything that will benefit the shad fisheries will work also for the benefit of the alewife.

## GENERAL RECOMMENDATIONS.

### ENFORCEMENT OF THE LAW.

As the law is at present constituted, it is quite difficult of enforcement in many instances. The procedure to be followed under the more important clauses is as follows: Some person must make an affidavit that he is informed and believes that the law is being violated at some particular place. This affidavit must be delivered to the Oyster Commissioner or Assistant Oyster Commissioner, whose duty it shall be "to go himself or send a deputy to such place, investigate same, and he shall seize and remove all nets or other appliances setting or being used in violation of this section, sell same at public auction and apply proceeds of sale to payment of cost and expenses of such removal, and pay any balance remaining to the school fund of the county nearest to where offense is committed." One of the most serious objections to this method of procedure is that in a strictly fishing community the odium attached to informing against violators of the fishing laws would prevent a person from making such an affidavit as required above unless he was being directly injured by the violation. Another objection is that the burden of prosecuting the suit is imposed upon the Oyster Commissioner. At present this official is compensated from a fund made up of license fees paid by the oystermen, and the latter object most decidedly to the oyster fees being diverted to the protection of the fisheries, which contribute not one penny towards this fund. The law provides, of course, for the payment of the expenses of suit out of the sale of the offending apparatus, but if the owner should fight the matter in the courts the expense of litigation might exceed the amount realized from such sale if the suit resulted in favor of the State, while if the suit is decided in favor of the fishermen the whole expense of the suit would be saddled upon the oyster fund. This is not just to the oystermen, as all of the license fees paid by them, over and above what is expended in the compensation of officials appointed to en-

force the oyster laws, is supposed to be expended in the direct work of bettering the condition of the oyster beds.

What the State of North Carolina needs is a commission of one or more practical men appointed for the sole purpose of conserving its fisheries. The fisheries of the State are of vast importance to its prosperity and too much cannot be done to foster them. During my investigation I found an almost unanimous sentiment in favor of such a commission, and a quite general willingness on the part of the fishermen to support it by means of license fees, as is now being done in the case of the oyster fishery.

### EARLY CLOSING OF SEASON.

At present shad fishing is permitted on the Cape Fear River as late as May 15th; in Pamlico County on the Neuse River until May 1st, and along the balance of the river until May 15th, while dutch or pound-nets are allowed in the Pamlico River until May 10th. Throughout the rest of the State there are practically no restrictions upon the length of time the shad fishermen shall work. It is, of course, obvious that the late runs of shad comprise the ripest females, and these are the ones which should receive the most protection. After the middle of April there is but little profit to the fishermen in shipping shad, as the northern markets are then well supplied with fish from Chesapeake and Delaware bays, and the price is necessarily quite low. If these late shad were permitted to spawn unmolested by man they would undoubtedly benefit the fishery wonderfully, and I would recommend that this be done. The fishermen along the upper reaches of the river could be permitted to work from a week to ten days longer than those near the mouths or in the sounds, as it would take about that length of time for the last run upon which the latter had worked to reach the upper courses of the rivers. I would suggest the following basis upon which to work:

**Cape Fear River.**— All shad apparatus below the mouth of Black River to be out by April 20th; all above this point to be out by May 1st.

**Northeast Cape Fear River.**—All shad apparatus below Castle Hayne to be out by April 20th, and all above that point to be out by May 1st.

**Black and other tributaries of the Cape Fear River.**— All shad apparatus to be out by May 1st.

**Neuse River.**—All shad and alewife apparatus operated at or below the town of New Bern to be out by April 20th, and all above that town to be out by May 1st.

**Pamlico and Pungo River.**—All shad and alewife apparatus to be out by April 20th.

**Tar River.**—All shad and alewife apparatus to be out by May 1st.

**Pamlico, Roanoke and Croatan Sounds.**—All shad and alewife apparatus to be out by April 20th.

**Albemarle Sound and Tributaries.**—In that portion of the sound east of the Perquimans River on the north and Ship Point on the south, all netting to be out by April 20th (this to apply also to the tributaries of the sound in this section). West of the above points and in the tributaries of that portion of the sound all netting to be out by May 1st.

## LOCATION OF FIXED SHAD APPARATUS.

As ordered, I plotted on government charts all the fixed apparatus (except stake gill-nets) used for shad during the season of 1906, and copies of these charts are attached hereto. It should be distinctly understood that the location of these nets, and the distance each string is run from the shore or shoal, is merely approximate, as it would have required the services of a surveyor and a long period of time to have shown the exact location and length of each string, and the time during which they are in the water is too limited for that. The stake gill-nets are not shown because of their large number in certain places, and the impossibility of plotting them in the limited space available on even the largest scale chart issued by the government. The main Cape Fear River is not included because only gill-nets and a very few seines were operated on the river. Whenever possible, sections of the rivers in which no fixed apparatus was set have been omitted in order to reduce the number and size of the charts as far as possible. Copies of charts showing the location of fixed apparatus set for shad in the Neuse, Pamlico, and Pungo rivers, Pamlico, Croatan, and Roanoke sounds, and Albemarle Sound and tributaries for the season of 1904, are also included in order that the changes made in two seasons from natural causes, and from the operation of the Vann law, may be shown.

## PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

### BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill. *In press.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*

8. Water-powers in North Carolina, by George F. Swain, Joseph H. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 5 cents.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

### ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

## PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

### BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill. *In press.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*

8. Water-powers in North Carolina, by George F. Swain, Joseph H. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage 4 cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage 4 cents.*

12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 5 cents.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage 4 cents.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

### ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

## PUBLICATIONS OF THE NORTH CAROLINA GEOLOGICAL SURVEY.

### BULLETINS.

1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Postage 10 cents.*

2. Building Stone in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill. *In press.*

3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

5. The Forests, Forest Lands and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *Postage 5 cents.*

6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Postage 10 cents.*

7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *Postage 5 cents.*

8. Water-powers in North Carolina, by George F. Swain, Joseph H. Holmes and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *Postage 16 cents.*

9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Postage ½ cents.*

10. Gold Mining in North Carolina and other Appalachian States, by Henry B. C. Nitze and A. J. Wilkins, 1897. 8°, 164 pp., 10 pl. *Postage 10 cents.*

11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *Postage ½ cents.*

12. Drinking Water Supplies in North Carolina, by Joseph A. Holmes. *In preparation.*

13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Reis, 1897. 8°, 157 pp., 12 pl. *Postage 10 cents.*

14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Postage 5 cents.*

15. Mineral Waters of North Carolina, by F. P. Venable. *In press.*

16. A List of Elevations in North Carolina, by J. A. Holmes and E. W. Myers. *In preparation.*

17. Historical Sketch of North Carolina Scientific and Economic Surveys; and Bibliography of North Carolina Geology, Mineralogy and Natural History, by J. A. Holmes and L. C. Glenn. *In preparation.*

18. Road Materials and Construction, by Joseph A. Holmes and William Cain. *In preparation.*

19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglass B. Sterrett, 1905. 8°, 64 pp., 8 figs. *Postage ½ cents.*

20. The Loblolly Pine in Eastern North Carolina, by W. W. Ashe. *In preparation.*

### ECONOMIC PAPERS.

1. The Maple-Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *Postage 2 cents.*

2. Recent Road Legislation in North Carolina, by J. A. Holmes. *Out of print.*

3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *Postage 2 cents.*

4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp., and map. *Postage 2 cents.*

5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Postage 4 cents.*

7. Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *Postage 2 cents.*

8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *Postage 4 cents.*

9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *Postage 4 cents.*

10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Postage 2 cents.*

11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. *In preparation.*

12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb. *Postage 4 cents.*

---

REPORTS ON RESOURCES.

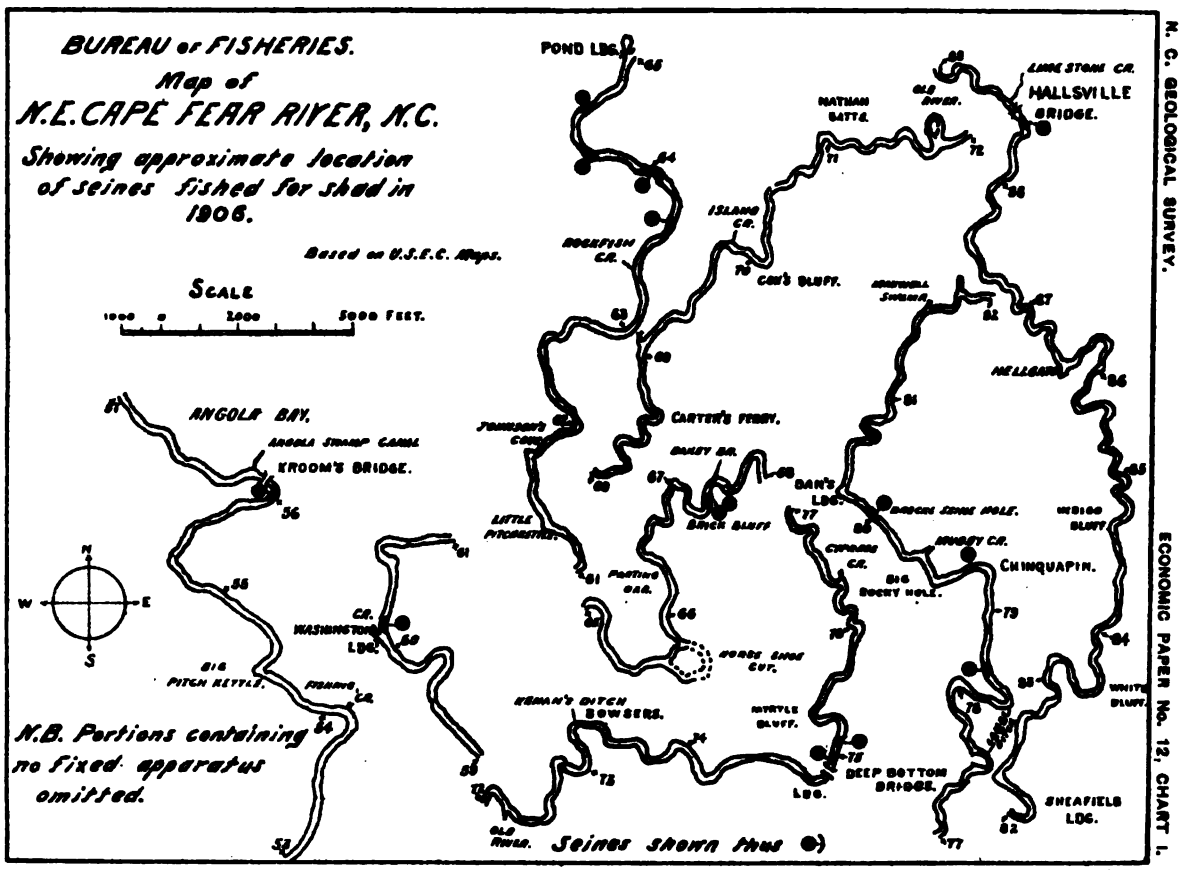
Vol. 1. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis. *Postage 32 cents.*

Vol. 2. Fish and Fisheries in North Carolina, by H. M. Smith. *In press.*

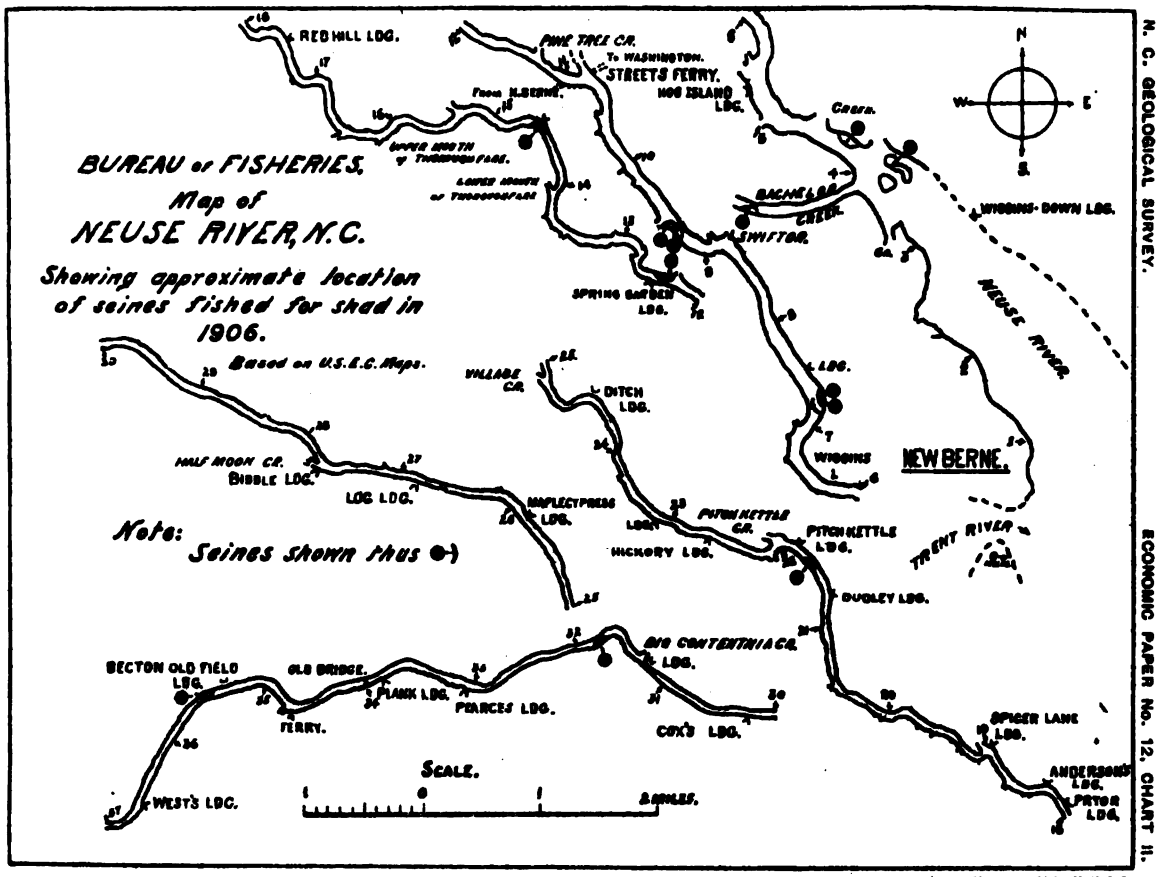
Vol. 4. Miscellaneous Mineral Resources in North Carolina, by Joseph Hyde Pratt. *In preparation.*

---

These publications are mailed to libraries and to individuals who may desire information on any of the special subjects named, free of charge, except that in each case applicants for the reports should forward the amount of *postage* needed, as indicated above, for mailing the bulletins desired, to the *State Geologist, Chapel Hill, N. C.*

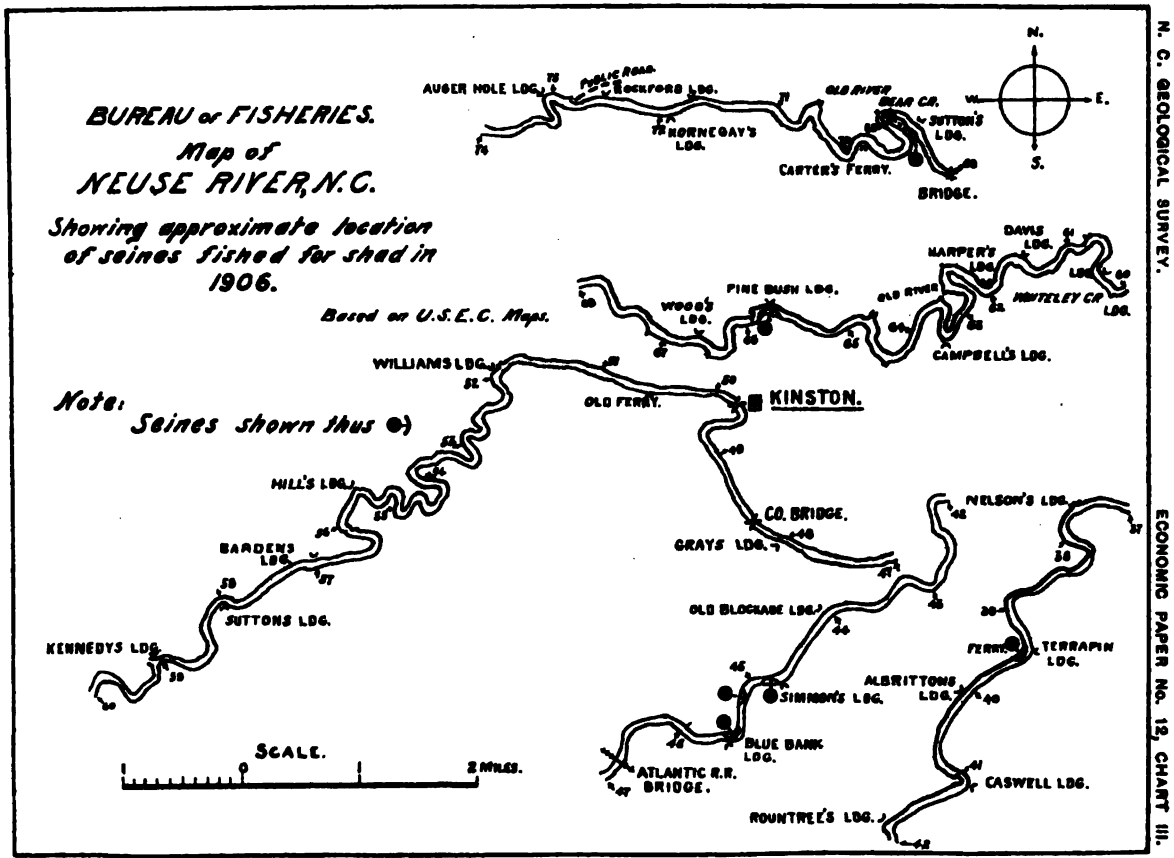



N. C. GEOLOGICAL SURVEY. ECONOMIC PAPER No. 12, CHART I.




N. C. GEOLOGICAL SURVEY. ECONOMIC PAPER No. 12, CHART II.

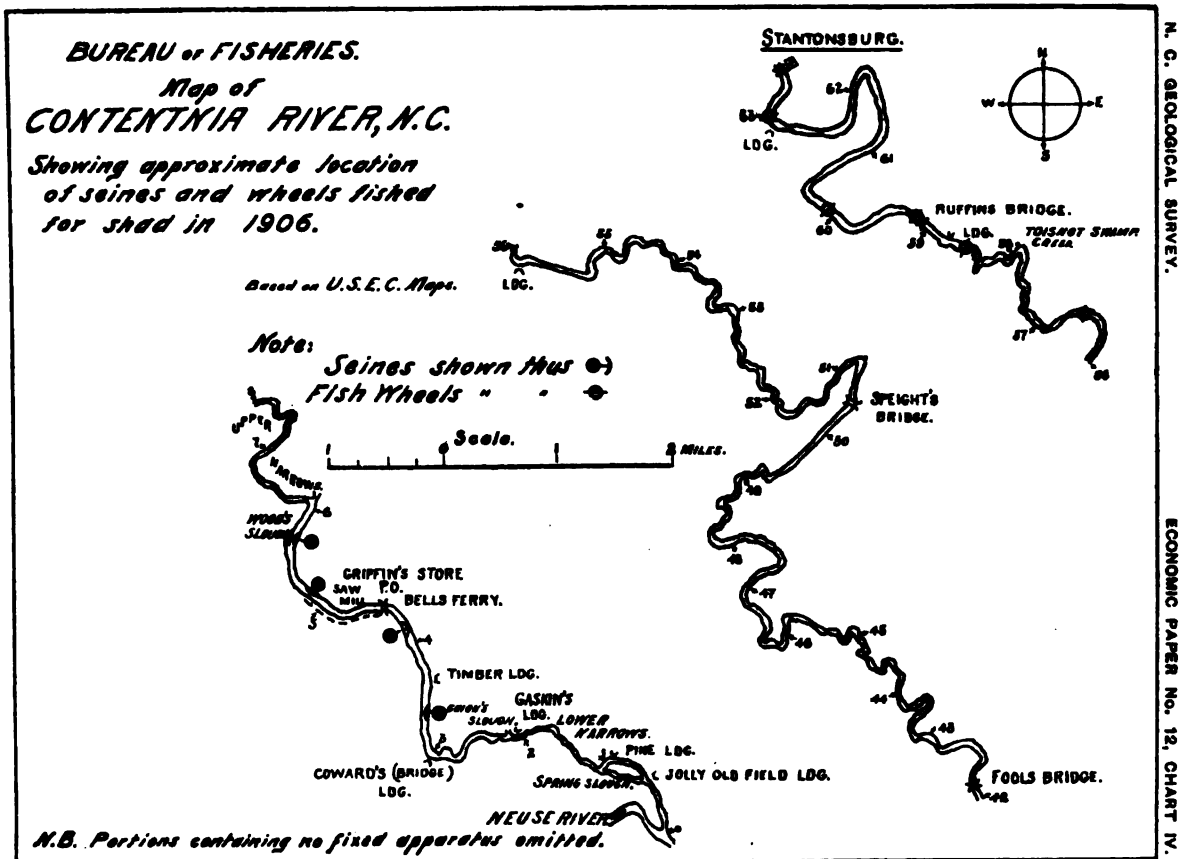
THE NORRIS PETERS CO., WASHINGTON, D. C.




THE GIBBS PETERS CO., WASHINGTON, D. C.

N. C. GEOLOGICAL SURVEY.

ECONOMIC PAPER NO. 12, CHART III.




N. C. GEOLOGICAL SURVEY. ECONOMIC PAPER No. 12, CHART IV.

THE HORRIS PETERS CO., WASHINGTON, D. C.

5/30/96

35 sheets

| | DATE DUE | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |